A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

JULY, 1935.

GENERAL PHYSICS.

ADSORPTION.

2779. Interaction of Atoms and Molecules with Solid Surfaces. Part I. J. E. Lennard-Jones and C. Strachan. Part II. C. Strachan. *Roy. Soc., Proc.* 150*A. pp.* 442–464, *June* 1, 1935.—In Part I the behaviour of an atom or molecule adsorbed on the surface of a solid is investigated by wave mechanics. Formulæ are found for the mean interval between successive excitations from the state of lowest vibrational energy to various excited states and for the mean time during which the atom remains in an excited state. An application is suggested to the theory of the migration of atoms along surfaces. In Part II a formula is obtained for the probability of evaporation of an adsorbed atom or molecule from a solid surface. The theory is applied to the evaporation of H_2, HD, and D_2 from a metal and it is shown that over a wide range of temperature the average length of time spent by HD on copper is about four to six times that of H_2, while the time spent by D_2 is about 20 times as long as that of H_2. AUTHORS.

2780. Interaction of H_2 with Micro-Crystalline Charcoal. Part I. R. M. Barrer and E. K. Rideal. Part II. R. M. Barrer. *Roy. Soc., Proc.* 149*A. pp.* 231–269, *April* 1, 1935.—The stability and crystallisation of charcoal adsorbents are studied after outgassing; X-ray analysis shows all the absorbents to be crystalline, graphitisation occurring slowly even at 670° K, though rapidly at 1270° K. Only a small part of the internal surface (as deduced from the X-ray measurements) is available to H_2 at saturation. At and below 273° K. the adsorption isotherm is of the composite Langmuir form $x/m = ap/(1 + ap) + a'p/(1 + a'p)$ owing to active ash-centres, but there is no evidence of active centres due to carbon alone. The kinetics of sorption of H_2, N_2 and O_2 at low temperatures obey solutions of Fick's diffusion law, the time processes having negligible temperature coefficient. At 78°K. D_2 is more strongly adsorbed than H_2, the relative rates of evaporation for H_2, HD and D_2 being respectively 1·25, 1·09 and 1·00. In Part II the study of activated sorption is extended to methane. Some H_2 is always present in the gas phase at low pressures, whether equilibrium is approached from the side of pure methane or of pure H_2; at higher pressures traces of methane are formed. Data for the energy of activation in the sorption of H_2 and CH_4 are derived and used in a discussion on the mechanism of sorption, regarded as chemisorption, in which double or triple bonds of the C atoms are hydrogenated. L. V. C.

ATOMIC AND MOLECULAR STRUCTURE.

2781. Physics of the Atom. E. N. da C. Andrade. *Phys. Soc., Reports, pp.* 269–320, 1934.

2782. Lower Limit of the Nuclear Photoelectric Effect of Beryllium. L. Arzimowitsch and P. Palibin. *Phys. Zeits. d. Sowjetunion,* 7. 2. *pp.* 245–254, 1935. *In German.*—The nuclear photoelectric effect of Be^9 is studied, using artificial γ-rays from an X-ray tube working at voltages from 950 to 1350 kV. The existence of the effect should be indicated by the induced β-ray activity of Br under the bombardment of the ejected neutrons, but all the results are negative up to the maximum voltage quoted. It is concluded that the lower limit of the effect must be higher than 1300 kV, whence calculation shows that the mass of the neutron should be $n = 1{\cdot}00127$. The discordance between this value and that obtained by Joliot and Chadwick leads to the conclusion that the interaction of the Be^9 with the quantum $h\nu$ involves the mechanism $Be^9 + h\nu \rightarrow Be^8 + n^1$; $Be^8 \rightarrow He^4 + He^4$. It is suggested that the Be^9 nucleus contains only one completed α-particle. The recent experiments of Gentner are subjected to criticism. L. A. W.

2783. Excitation of the Nitrogen Nucleus to H-Ray Emission by α-Rays from Polonium. H. Stegmann. *Zeits. f. Physik,* 95. 1–2. *pp.* 72–83, *May* 14, 1935.—The nuclear protons liberated from nitrogen were investigated by means of α-rays from Po. Three different groups of protons are produced of ranges, 56, 81·5, and 101·5 mm. There are two different types of groups. In the resonance groups A and C range and number of particles remain constant with varying α-ranges. The α-particle is captured. A line spectrum is produced. The remaining part of the nucleus is an oxygen isotope of mass 17, as may be seen from the distribution of direction of the H-particles from N. The H-particles of the groups A and C are excited only by definite α-ranges. There is evidence that in the group B the α-particle is captured. There results the residual nucleus O^{17}. This group exhibits a normal excitation process. The excitation function of the nitrogen is given in the group A by $R_\alpha = 2{\cdot}2$ cm., and in the group C by $R_\alpha = 2{\cdot}6$ cm., whilst the third group arises both from slow and from rapid α-particles. J. J. S.

2784. Number and Range of the Nuclear Protons Liberated from Aluminium and Nitrogen by α-Rays. H. Pose. *Zeits. f. Physik,* 95. 1–2. *pp.* 84–92, *May* 14, 1935.—A discussion is given of the various measurements which have been made of the number and range of the nuclear protons liberated by α-rays from Al and N, and the contradictions which occur are examined with a view to their explanation. J. J. S.

2785. Disintegration of the Deuton by Impact. J. R. Oppenheimer. *Phys. Rev.* 47. *pp.* 845–846, *June* 1, 1935.—High energy deutons can be disintegrated by their impact with nuclei. For deuton energies $\sim 2 \times 10^7$ eV, the corresponding neutron yield can be of the order of 1 %. The probability of the process can be calculated by taking advantage of the fact that the nuclear field varies little over the deuton, and is then given quite simply in terms of the photoelectric absorption and the matrix elements of the nuclear field acting on the deuton. For low energies the neutron yields are small, amounting to 3×10^{-9} for 3×10^6 eV deutons in Al, and to 10^{-6} for 4×10^6 eV deutons in C. AUTHOR.

2786. Investigation of the Disintegration of Light Elements with a Double Counter. J. Schintlmeister and G. Stetter. *Akad. Wiss. Wien, Ber.* 143. 2*a*. 8–10. *pp.* 597–617, 1934.—Continuing the work of Pettersson and Schintlmeister [see Abstract 9 (1935)] the production of protons of energy less than that of the reflected α-particles was examined for light elements up to Cl_2 using a double counter. Since reduction in the velocity of the incident α-particles by the interposition of sheets of absorber produced little increase in the number of short range protons, the observed number gave the total yield. A yield-atomic number curve reaches a maximum with nitrogen and then falls approximately exponentially. Detailed examination of the curve shows a periodic variation, the elements of odd number always giving a greater yield than those of even number. The periodicity is most marked in the neighbourhood of the maximum since C and O give no measurable yield; the variations become progressively less pronounced with increase in atomic number. The number of reflected α-particles examined over various angular distributions increased continually with atomic number and exhibited no irregularity. F. C. C.

2787. Relative Abundance of the Isotopes of Potassium and Rubidium. H. Bondy, G. Johannsen and K. Popper. *Zeits. f. Physik*, 95. 1–2. *pp.* 46–52, *May* 14, 1935.—The relative abundances of the isotopes of K and Rb are measured with a mass spectrograph having both directional and velocity focusing [see Abstract 3748 (1933)]. In the case of potassium the relative abundance is measured for several sources of different composition and for several emission temperatures, but no dependence of the relative abundance on these conditions is observed. The measured values of the abundance ratios are $K^{39} : K^{41} = 16 \cdot 2 : 1 \cdot 0$ and $Rb^{85} : Rb^{87} = 2 \cdot 68 : 1 \cdot 0$. J. E. K.

2788. Capture of Slow Neutrons by Light Nuclei. F. Perrin. *Comptes Rendus*, 200. *pp.* 1749–1751, *May* 20, 1935.—The large effective cross-section of light elements, *e.g.*, Li or B, for capture of slow neutrons is shown to be inversely proportional to the velocity of the neutron, that for a neutron of the energy of ordinary thermal agitation being of the order 10^{-20} cm.^{2}; it is explicable by a diffraction phenomenon due to strong interaction between the neutron and the nuclear particles within the nucleus [see Abstract 1306 (1935)]. C. A. S.

2789. Atomic Disintegration by Neutrons. Elisabeth Matzner. *Akad. Wiss. Wien, Ber.* 143. 2*a*. 8–10. *pp.* 579–590, 1934.—Describes the investigation by the scintillation method and the cloud-chamber method of the tertiary radiation produced by bombardment of elements by Po + Be neutrons. Fifteen elements were investigated. The yield of tertiary radiation is greatest in the case of C and Ni and smallest in the case of Pb and Sn. These elements are those which Fermi found to yield no radioactive product when bombarded by Em + Be-neutrons and reasons for this are proposed. W. E. P.

2790. Theory of Disintegration of Nuclei by Neutrons. H. A. Bethe. *Phys. Rev.* 47. *pp.* 747–759, *May* 15, 1935. The large cross-section for capture and for elastic scattering of slow neutrons (the one normally accompanies the other) are accounted for by wave mechanics. The conditions for elastic scattering (*a*), capture with emission of γ-rays (*b*), disintegration with emission of an α-particle (*c*), or of protons (*d*), and excitation of the nucleus without capture or emission (*e*), are deduced. (*b*) is only possible if there is an unoccupied p level for the neutron inside the nucleus; (*c*) should not occur with slow or fast neutrons for elements of $z > 17$ or 27 respectively; (*d*) is only possible with fast neutrons and elements ordinarily of $z \ngtr 20$, though weak effects may be observed for those of $z \ngtr 40$, or in case of resonance $\ngtr 60$; for (*e*) the cross-section must be of the order of 10^{-25} cm.^{2} C. A. S.

2791. Neutron-Proton Interaction. Part I. Binding Energies of the Hydrogen and Helium Isotopes. E. Feenberg. *Phys. Rev.* 47. *pp.* 850–856, *June* 1, 1935.—In the present state of nuclear theory it is reasonable to assume, for particles bound in the same nucleus, that the neutron-proton interaction operator can be represented fairly well by a potential function $J\ (r)$. By taking $J\ (r)$ to have the form Ae^{-ar^2}, which is well adapted to the discussion of the three- and four-body problems, A and a have been determined to fit the binding energies of the deuton and the α-particle. The results are roughly $A = 170\ mc^2$, $1/a^{1/2} = 1 \cdot 3 \times 10^{-13}\ mc$, with both the Wigner and Majorana theories. The computed binding energy of H^3 has the value $12 \cdot 7\ mc^2$ (Wigner) or $11 \cdot 2\ mc^2$ (Majorana), not very far below the experimental value of $16\ mc^2$. The two theories appear to be about equally good. [See following Abstract.] AUTHOR.

2792. Neutron-Proton Interaction. Part II. Scattering of Neutrons by Protons. E. Feenberg. *Phys. Rev.* 47. *pp.* 857–859, *June* 1, 1935.—It may be that also for free particles, as well as in the case of binding, the neutron-proton interaction operator can be represented by a potential $J_1(r)$. Because the conditions of binding and of scattering are so different there is no reason to expect J_1 to be identical with J, the potential for binding. The inequalities $J_1 < J$ and $\partial J_1/\partial W < 0$ (W denotes the kinetic energy) should hold if some part of the potential results from a polarisation of each particle in the field of the other or from a high-frequency exchange process. For slow neutrons a 30 % *decrease* in the magnitude of the interaction in going from binding to free particles yields an *increase* in the cross-section for scattering by protons of several hundred % over the value given by J. This larger value is required by recent measurements. The rapid fall of the experimental cross-section with increasing W requires that J_1 decrease steadily as W is made larger in accordance with the relation $J_1(r,\ v) = e^{-g(\beta_0+v/c)} J(r)$. Here g is a positive constant, v is the relative velocity of the colliding particles and $\beta_0 c$ is identified with the average relative velocity of the particles in the deuton. [See preceding Abstract.] AUTHOR.

2793. Energy Spectrum of Neutrons from Disintegration of Beryllium by Deutons. T. W. Bonner and W. M. Brubaker. *Phys. Rev.* 47. *pp.* 910–913, *June* 15, 1935.—The energy distribution of the neutrons from the disintegration of Be by high speed deutons has been investigated by the method of recoil-protons in a high pressure cloud chamber. The maximum neutron energies which were observed correspond to an energy of disintegration of 4·14 MEV. The mass of Be^9 calculated from these data, assuming the reaction ${}_4Be^9 + {}_1H^2 \rightarrow {}_5B^{10} + {}_0n^1$, is $9 \cdot 0123 \pm 0 \cdot 0008$. Several other neutron groups of lower energies were observed which indicate that the B^{10} nucleus is left in one of several possible excited states. The excited B^{10} nucleus presumably falls to the normal state by the emission of a γ-ray. AUTHORS.

2794. Slowing Down of Neutrons in Various Substances Containing Hydrogen. T. Bjerge and C. H. Westcott. *Roy. Soc., Proc.* 150*A*. *pp.* 709–728, *July* 1, 1935.—A series of experiments is described in which the effect of slowing down neutrons in various hydrogen-containing substances is measured. With the aid of subsidiary experiments on the scattering and absorption of slow neutrons by various nuclei, an interpretation of the results is suggested in which it appears that the neutrons slowed down in water or paraffin have to a large extent attained gas-kinetic velocities. The cross-sections for scattering of such slow neutrons are shown to be about 3×10^{-23} cm.² for the hydrogen nucleus, 3×10^{-24} cm.² for carbon, and roughly the same for oxygen. The cross-section for absorption of these neutrons is $1 \cdot 2 \times 10^{-21}$ cm.^{2} for boron, $< 2 \times 10^{-24}$ cm.^{2} for nitrogen, about 4×10^{-25} cm.^{2} for oxygen and carbon, and about 2×10^{-25} cm.^{2} for hydrogen. The last two figures are subject to revision, although the value 8×10^{-25} cm.^{2} for the combinations H_2O and CH_2 is fairly well determined. AUTHORS.

2795. Canonical Structures for Hydrocarbons. G. W. Wheland. *J. Chem. Phys.* 3. *pp.* 356–361, *June*, 1935.—A procedure is outlined for obtaining the number of canonical structures of each degree of excitation for an arbitrary hydrocarbon molecule. The results are applied to the approximate calculation of the energies of a number of such systems. AUTHOR.

2796. Change in Properties of Water Around 40° C. M. Magat. *J. de Physique et le Radium*, 6. *pp.* 179–181, *April*, 1935.—The intramolecular bands of water disappear in the Raman spectrum at temperatures above 37° C. This has led the author to look for anomalies in other properties of water. He finds that all known properties present irregularities in the temperature-interval 35–45° C. H. L. B.

2797. Modes of Vibration of Butane and Pentane. Free Rotation about Carbon-Carbon Bonds, and a New Type of Stereoisomerism. L. S. Kassel. *J. Chem. Phys.* 3. *pp.* 326–335, *June*, 1935.—The Hamiltonian function for a chain of 4 C atoms with the simple valence force system potential energy is transformed by successive changes of variables to such a form that the wave equation is nearly separable into 5 harmonic oscillator equations and one governing the internal rotation. The latter has been solved numerically for 12 different rotational levels of the non-vibrating molecule, some of which actually correspond to rotations, and others to a torsional oscillation of restricted amplitude about either the *cis* or the *trans* position. The remaining terms in the wave equation are treated as a perturbation, whose first-order energy is found to be less than 1 cm.$^{-1}$ for all moderately low vibrational states. Derived therefrom are 2 isomeric forms of butane with plane carbon skeletons, and another form in which 2 ethyl groups are rotating about the central C-C bond. The vibration frequencies for the 3 possible plane forms of a 5-carbon chain have been calculated. When the frequencies of C_2, C_3, C_4 and C_5 are calculated with the same 2 force constants throughout, and by taking account of the 2 plane forms of C_4 and the 3 of C_5, the results are in fair agreement with Raman and infra-red lines. An Appendix deals with the kinetic energy of a rotating molecule. H. H. Ho.

2798. Fifth Report of Committee on Atomic Weights of International Union of Chemistry. G. P. Baxter, O. Hönigschmid, P. Lebeau and R. J. Meyer. *Am. Chem. Soc., J.* 57. *pp.* 787–794, *May*, 1935. *Chem. Soc. J. pp.* 788–795, *June*, 1935.—The only change proposed is for Nb from 93·3 to 92·91, but that of Eb to 165·20 should not have been inserted last year [see Abstract 2272 (1934)]. Results discussed but not held to justify change are: Batueca's deduction of 12·005 for C from the density of C_3H_6; Moles and others 12·006(5) for C and 14·0083 and 14·007 for N from densities; Johnson's 22·994 for Na; Smith and Tait's results for Ca; Heuse and Otto's for Kr; Lautié's 96·01–96·02 for Mo; and Baxter and Hales' results for I, C, and Na and Baxter and Thomas's for Cs (132·911). Aston's determination of the isotopes of the rare earths [see Abstract 3078 (1934)] indicate discrepancies from the international table for Ho 1·4, Nd 0·8, Er and Tm 0·5, Gd 0·4, Sm and Tb 0·3, Yb 0·2, and Eu and Lu 0·1.

Marble determined 206·054 for radiogenic Pb from pitchblende from the Great Bear Lake, Aston's figure being 206·08. C. A. S.

2799. Atomic Weight of Protactinium. A. V. Grosse. *Roy. Soc., Proc.* 150*A*. *pp*. 363–371, *June* 1, 1935.—Experiments are described by which the atomic weight of the rare radioactive element protactinium (91) has been determined for the first time by chemical methods. Owing to the scarcity of material available the compound K_2PaF_7 was employed and its stability shown to be suitable for the purpose. The results are in agreement with the whole number value 231 to within the accuracy of experiment and so support the view that the final product of its radioactive disintegration is the lead isotope of mass 207. AUTHOR.

See also Abstracts 2832, 2856, 2955, 2957, 3050, 3068, 3091, 3098, 3108, 3125, 3154, 3167.

COLLOIDS.

2800. Action of Electrolytes on Hydrophobic Colloids. H. R. Kruyt. *K. Akad. Amsterdam, Proc.* 38. 5. *pp*. 464–470, 1935.—There are two possible actions of anion on a sol. The ζ-potential can be altered either by a change of the ϵ-potential or by an alteration of the distribution of the counter ions of the double layer. Some cases of ionic antagonism are explained. A. S. C. L.

2801. Bubble-Tube Method of Measuring Electroendosmosis. F. Fairbrother and A. E. Stubbs. *Chem. Soc., J. pp*. 527–529, *April*, 1935.—Discussion of experimental conditions to be satisfied for the accurate functioning of this method. A. S. C. L.

2802. Electrokinetic Potential of Silver Iodide. G. N. Gorochovsky. *J. Phys. Chem*. 39. *pp*. 465–475, *April*, 1935.—Electrokinetic potentials of sols of AgI with $M/400$, $M/4000$ and $M/20{,}000$ AgI made in different excesses of ions (silver or iodide) were electrophoretically measured. The curves ζ–$C_{\text{electrolyte}}$ of AgI sols do not coincide with the curve in the case of endosmose through the precipitate (Lange and Crane). The less the concentration of the dispersed phase in sols, the greater are the concentrations of Ag ion necessary to charge it positively and the further the isoelectric point is removed from the point of equivalence in the direction of the excess of Ag ions. The dilution of sol $M/400$ AgI by means of solutions containing the same quantities of excess electrolyte as the initial sol leads also to decrease of positive charge of the sol. The alteration of the concentration of dispersed phase does not cause any change of pH of the sols. AUTHOR.

***2803. Critical Comparison of Electrophoresis, Streaming Potential, and Electroosmosis. H. B. Bull.** *J. Phys. Chem.* 39. *pp*. 577–583, *May*, 1935.—A new electrophoretic cell is described. The electrophoretic, electroosmotic, and streaming potential methods of measuring the electrokinetic potentials are compared, using the same solution and surface. Good agreement is found when dealing with protein-coated surfaces. Poor correspondence is found between electrophoresis and streaming potential for quartz and cellulose surfaces. AUTHOR.

2804. Isoelectric Points at Glass and Gelatin Surfaces. Betty Monaghan, H. L. White and F. Urban. *J. Phys. Chem.* 39. *pp*. 585–591, *May*, 1935.—The isoelectric concentration for electroosmosis and electrophoresis on Pyrex glass is found to be for Th about seven and for Al and Fe about three times as great as the isolelectric concentration for stream potential on the same kind of glass. The H-ion isoelectric concentration for gelatin, on the other hand, is the same for electroosmosis, electrophoresis, and stream potential. The results are explained on the assumption that only the diffuse component of the double layer is moved by hydrostatic forces, while both the diffuse and the outer Helmholtz layers move in an electric field. AUTHORS.

2805. Ionic Exchange in Relation to the Stability of Colloidal Systems. H. Jenny and R. F. Reitemeier. *J. Phys. Chem.* 39. *pp.* 593–604, *May,* 1935.—ζ-potentials of Putnam clay particles depend on the charge and size of the adsorbed ion. For rare-gas type ions of equal size, the potential tends to be lower as the valency of the ion is higher. If the charge of the ion is kept constant, the potential is higher as the adsorbed kation (crystal lattice radii) is smaller. Colloidal particles with high potentials carry adsorbed ions which are easily exchangeable. The ease of replacement increases as the sixth power of the ζ-potential. Data indicate the existence of a maximum potential which amounts to about 62 mV. The flocculation value of a given electrolyte increases potentially with the ζ-potential. The critical potential was found to be 42 mV. The valency rule of Schulze-Hardy is grossly violated in the case of clay systems. For monovalent kations the flocculation value is the higher the smaller the size of the ion. The flocculating power of a kation is a positive exponential function of its ionic exchange ability. A detailed picture of the mechanism of flocculation in relation to ionic exchange is presented. AUTHORS.

2806. Surface Conductivity Measurements in Pyrex Slits. F. Urban, S. Feldman and H. L. White. *J. Phys. Chem.* 39. *pp.* 605–609, *May,* 1935.—Specific surface conductivities of Pyrex slits were determined with 1000-cycle a.c. ($1 \cdot 25 \times 10^{-4}$ to 1×10^{-2} *M* KCl) and with d.c. (5×10^{-4} *M* KCl). The apparent d.c. specific surface conductivity is lower than a.c. surface conductivity. This is due to membrane potentials. The apparent d.c. specific surface conductivity of fractured glass agrees with that obtained previously in smooth capillaries. [See Abstract 4693 (1932).] AUTHORS.

2807. Electrolyte Concentration and Ratio of Electroosmotic to Electrophoretic Mobilities. H. L. White, Betty Monaghan and F. Urban. *J. Phys. Chem.* 39. *pp.* 611–622, *May,* 1935.—The influence of electrolyte concentration of medium on the ratio of electroosmotic to electrophoretic velocities with bare glass and gelatin-covered particles of 1 to 3μ dia. has been investigated. The ratio is unity with either type of surface with a concentration between 10^{-3} and 10^{-2} *M* and at all higher concentrations. With lower concentrations the ratio increases progressively with decreasing concentration, reaching values above 3 in distilled water. A discussion of various factors which may contribute to this result is given. AUTHORS.

2808. Liesegang Rings. E. B. Hughes. *Kolloid Zeits.* 71. *pp.* 100–103, *April,* 1935.—Analytical investigations on the distribution of electrolytes in band and continuous precipitates in gels shew that concentration gradients correspond with the effects of diffusion, which is the controlling factor as to whether band or continuous precipitation shall take place (under definite and proper conditions of solution, etc.). A theory is developed from the experimental results obtained, and from this the necessary conditions for the formation of individual rings are deduced. J. K.

2809. Colloidal Air and Oxygen. A. Krause and K. Kapitańczyk. *Kolloid Zeits.* 71. *pp.* 55–60, *April,* 1935.—Air and oxygen sols are prepared from highly concentrated caustic soda solutions ($18 \cdot 55N$ to $19 \cdot 60$ N NaOH; 5°) and distilled water (15°) by mixing 10 c.c. of caustic soda solution with 1 c.c. distilled water. The mixture is quickly cooled to 5° and for air bubbles diluted 8000 times. The size of the bubbles is determined by counting under the ultra-microscope at different dilutions. At 8000 dilution the size is 24–27 $\mu\mu$. By further dilution the size cannot be lowered. According to surface tension and capillary pressure measurements the size of the smallest ultra-microscopic air bubbles is less than 5 $\mu\mu$. Their transparency is mainly dependent on the difference in the refractive index of the components of the gas-fluid system. The refracture index of the NaOH solutions is $n_0 = 1 \cdot 43$ to $1 \cdot 44$ (20°). For O_2 bubbles at 16,000 and greater dilutions the size of the bubbles by counting under the ultra-microscope is 18–19 $\mu\mu$, while with reference to the aforementioned capillary pressure the size is $2 \cdot 9$ $\mu\mu$. [See also Abstract 1790 (1934).] J. K.

See also Abstracts 2970, 2973, 2989, 2990.

CRYSTAL STRUCTURE AND PROPERTIES.

2810. Dynamics of Molecular Crystal Lattices. Part II. Solid Nitrogen. V. Deitz. *Frank. Inst., J.* 219. *pp.* 565–571, *May*, 1935.—On the basis of London's results and Vegard's determination of the crystal structure the 48 distances between an atom of any molecule of solid N_2 and its twelve nearest neighbours, and also those between it and the 24 next nearest, are calculated. The constants of the lattice energy equation are then determined, and the repulsion between two N atoms of different molecules in the crystal shown to be less steep than that between two Ne atoms, which again is less so than that between two A atoms. The frequencies and nature of the lattice vibrations are next examined, the results confirming Vegard's interpretation. Lastly the heat capacity at temperatures up to 30° Abs. is deduced, the results agreeing well with experiment. [For Part I see Abstract 2355 (1935).] C. A. S.

2811. Direct Method for the Determination of the Components of Interatomic Distances in Crystals. A. L. Patterson. *Zeits. f. Krist.* 90. *pp.* 517–542, *June*, 1935. *In English.*—Part I of the paper deals with the Fourier series F^2 (hkl), a weighted average electronic distribution about any point in the crystal. The peaks occur at points closely corresponding with the inter-ionic distances. A weighted average distribution of atomic centres is obtained from a second series, thus affording increased resolution. The numerical results are good. Examples are discussed in Part II. F. I. G. R.

2812. Tabulated Data for the Seventeen Plane Groups. A. L. Patterson. *Zeits. f. Krist.* 90. *pp.* 543–554, *June*, 1935. *In English.*—Interatomic distances can be computed from the tables. The data are derived from the theory of plane groups, and interatomic vectors are also given. These vectors themselves form a plane group which has the same symmetry as the original group. If the latter has no centre of symmetry such a centre appears in the plane group of the vector. F. I. G. R.

2813. Molecular Bond in Rock-Salt. R. Reinicke. *Zeits. f. phys. Chem.* 28. *Abt.B.* 6. *pp.* 411–426, 1935.—An extension of previous work in which a geometrical interpretation (cubes and tetrahedra) of forces acting within the lattice is developed. The rock-salt lattice is now conceived as an assemblage of charges, rather than of masses. Geometrical groups are discussed for the appearance of ions. F. I. G. R.

2814. Theory of Super-Lattice Structures in Alloys. W. Hume-Rothery and H. M. Powell. *Zeits. f. Krist.* 91. *pp.* 23–47, *July*, 1935.—There are two distinct types of super-lattice; one in which the specific electrical conductivity shows a maximum corresponding to complete atomic re-arrangement, and another in which the conductivity shows no marked increase at low temperatures, and the alloy is more akin to a random solid solution. The paper represents an attempt to discover the ideal ordered structure at low temperatures. F. I. G. R.

2815. Lattice Constants of Elements of Hexagonal Structure. E. A. Owen, L. Pickup and I. O. Roberts. *Zeits. f. Krist.* 91. *pp.* 70–76, *July*, 1935. *In English.*—Using the same technique [see Abstract 4748 (1933)] and powdered (Mg foil) and annealed (Ru and Os for 4–5 hr. at 1000°) material the following parameters, *a* and *c*, were determined: Be 2·2812, 1·5685; Mg 3·2020, 1·6240; Zn 2·6591, 1·8560; Ru 2·6987, 1·5833; Os 2·7304, 1·5785, all to an accuracy of ± 0·0005. The results agree well with those previously obtained save for Be [see Abstract 4061 (1932)]. C. A. S.

2816. Deformation of a Crystal Lattice under the Influence of an Electric Field. H. Hulubei. *Comptes Rendus*, 200. *pp.* 1530–1532, *April* 29, 1935.—Preliminary X-ray experiments on quartz and mica, using the spectrograph previously described [see Abstract 220 (1935)], have revealed measurable changes in the lattice constants under the influence of static electric fields varying from 110 to 660 e.s.u. per cm. for mica and from 160 to 400 e.s.u. per cm. for quartz. The effect is composed of a displacement and a rotation of the planes, and the displacements pass through a maximum as the field increases. C. B. A.

2817. Atomic Distribution in Red and Black Phosphorus and Crystal Structure of Black Phosphorus. R. Hultgren, N. S. Gingrich and B. E. Warren. *J. Chem. Phys.* 3. *pp.* 351–355, *June*, 1935. —Crystalline and " amorphous " black and red P all give similar X-ray patterns indicating that the " amorphous " varieties consist of very small crystals. The lattice is side-centred orthorhombic, the unit cell has *a* 3·31, *b* 4·38, *c* 10·50 Å, and contains 8P, space group V_h^{18} — *Bmab*. The atoms are arranged in two double layers, each P having 3P at 2·18, and 12 at 3·6 Å. The structure allows of closer packing than that of As. C. A. S.

2818. Phosphides and Arsenides with Modified Nickel-Arsenide Structure. K. E. Fylking. *Arkiv f. Kem. Min. och Geologi*, 11*B*. *No.* 48. *pp.* 1–6, 1935. *In English.*—A number of crystals akin to NiAs were investigated, and shown to have orthorhombic symmetry, with the following parameters—in Ångstrom units:

	a	*b*	*c*
MnP	5·905	5·249	3·167
FeP	5·782	5·177	3·089
CoP	5·588	5·066	3·274
MnAs	6·38	5·63	3·62
FeAs	6·016	5·428	3·366
CoAs	5·96	5·15	3·51

F. I. G. R.

***2819. Lattice Constant of Galena Determined with a New X-Ray Spectrometer. E. v. Zeipel.** *Arkiv f. Mat. Astron. och Fysik*, *Stockholm*, 25*A*. *No.* 8. *pp.* 1–18, 1935. *In English.*—A new spectrometer, similar in principle to that of Larsson [see Abstract 2547 (1927)], and the method of its use are described in detail, the latter is exemplified by application to galena, using Ag-Kα, giving $a = 5\cdot923_{34}$ Å. C. A. S.

2820. Structure of Dibenzyl. Part II. Fourier Analysis. J. M. Robertson. *Roy. Soc., Proc.* 150*A*. *pp*. 348–362, *June* 1, 1935.—The results of a double Fourier analysis of three zones of structure factors from dibenzyl are described. The molecule is found to approximate in shape to the three-dimensional form indicated by the trial analysis, but the benzene rings (which are capable of free rotation, in the chemical sense, about the single bonds connecting them to the CH_2 groups) are apparently turned, in the crystal, from 13° to 16° out of the symmetrical position. The molecular dimensions and orientation have been determined, all the atoms in the molecule being defined in one or other of the electron density maps. The benzene rings are regular plane hexagon structures. The distance between aromatic C atoms is 1·41 Å, between aromatic C and the aliphatic CH_2 group, 1·47 Å, and between the two CH_2 groups, 1·58 Å. This latter value may be slightly over-estimated on account of the pair of H atoms attached to these groups. A direct measure is obtained of the angle between the bonds of the CH_2 group, the value being 109·2–112°. The mutual arrangement of the molecules prevents the aliphatic groups of neighbouring molecules approaching to within 5 Å from each other. Between aromatic and aliphatic C atoms, the minimum intermolecular distance is 4·10 Å, and between aromatic C atoms 3·68 Å. [For Part I see Abstract 4017 (1934).] AUTHOR.

2821. Orientation of the Oxalate Group in Oxalic Acid and its Salts. S. B. Hendricks. *Zeits. f. Krist.* 91. *pp*. 48–64, *July*, 1935. *In English.*—The crystal structure of α- and β-oxalic acids, $K_2C_2O_4\cdot H_2O$, $Rb_2C_2O_4\cdot H_2O$, KHC_2O_4 and $RbHC_2O_4$ have been determined from Weissenberg photographic data, and a partial analysis made of the structure of $NaHC_2O_4\cdot H_2O$. In these structures the atoms of the oxalate group are coplanar and the group is invariant in shape. Perfect cleavage obtains in those cases where planes can be passed through the structure without cutting across C_2O_4 or O-H-O bonds. The coordination of hydrogen in the two anhydrous forms of oxalic acid is similar to that in other acid compounds that have been studied. Refractive indices are given for the above compounds and for $(NH_4)_2C_2O_4\cdot H_2O$, $Na_2C_2O_4$, $Cs_2C_2O_4\cdot H_2O$, and $Li_2C_2O_4$. T. H. P.

2822. Crystal Growth and Crystal-Particle Formation. I. N. Stranski and R. Kaischew. *Phys. Zeits.* 36. *pp*. 393–403, *June* 1, 1935.—The equilibrium of (*a*) an infinite crystal and (*b*) a finite crystal is considered in terms of the vapour-pressure equation. The Thomson-Gibbs equation is derived, from which it appears that each crystallite is associated with a perfectly definite vapour-pressure, but the converse is not true, since any discrete values are permissible. Consideration of the mean work of separation $\overline{\phi}$ shows that, for general equilibrium, the mean work $(\overline{\phi}a_3)$ for particles of three dimensions for a complete surface is equal to the mean work per particle of two dimensions for the row at the edge of such a surface. F. I. G. R.

2823. Twinning of Single Crystals of Tin. B. Chalmers. *Phys. Soc., Proc.* 47. *pp*. 733–746, *July*, 1935.—Methods are described for the production of single crystals of tin and for the termination of their orientations by optical measurements. The conditions under which parts of the crystals can be caused to twin by impact or by tension are investigated, and the determination of the energy relations for certain controlled cases is described. It is found that when twinning occurs, energy amounting to 8×10^5 ergs is converted into heat per cm.^{3} of crystal twinned. The process of twinning in relation to the crystal structure of tin is discussed. AUTHOR.

2824. Velocity of Elastic Waves in a Mercury Crystal and the Characteristic Temperature. E. Grüneisen and H. Hoyer. *Ann. d. Physik*, 22. 7. *pp*. 663–673, *May*, 1935.—The velocities of elastic waves in various directions in a mercury crystal are calculated from values of the elastic constants of mercury at − 190° C. The value of the Debye characteristic temperature, appropriate to the T^3 region of specific heat variation is 68·6°. [See Abstract 1699 (1935).] J. S. G. T.

***2825. X-Ray Goniometer for Investigation of Crystal Structure of Solidified Gases. W. H. Keesom and K. W. Taconis.** *Physica*, 2. *pp*. 463–471, *May*, 1935. *In English*.—A method is developed for determining the crystal structures of solidified gases in those cases in which the Debye-Scherrer method does not yield sufficient data. A single crystal, arbitrarily orientated, is rotated in the axis of a Debye-Scherrer camera, and the film is moved as in Weissenberg's goniometer. The crystal structure of ethylene is determined and a rhombic cell with 2 molecules per cell is found: $a = 6\cdot46$, $b = 4\cdot87$, $c = 4\cdot14$ Å at − 175° C. Density 0·717. AUTHORS.

2826. Methods of Structure Determination. A. Hettich. *Zeits. f. Krist.* 90. *pp*. 473–492, *June*, 1935.—The author considers the technique of structure determination. The indexing of Weissenberg photographs is dealt with, and the use of the X-ray goniometer for adjusting specimens is discussed. The times of reflection in rotation photographs, are considered. A method is given for dealing with the contributions of atomic groups to the structure factor. Finally the photographic summation of Fourier series is described. In a note, **P. P. Ewald**, *ibid. pp*. 493–494, questions the legitimacy of calculating the effect of atomic groups without taking into consideration the lattices into which they are built. J. T.

2827. Linear Crystal Grating of AgCN. C. D. West. *Zeits. f. Krist.* 90. *pp*. 555–558, *June*, 1935. *In English*.—Crystals of AgCN, obtained from an ammonia solution are used as linear gratings for X-rays. It is concluded that the resulting diffraction pattern is due to random translations of individual parallel extended chains – Ag – C – N – Ag – along their axes from the points of the space lattice. J. T.

***2828. Transmission Photograms of Single Crystals with Swift Electrons, and their Application to Structure Determinations. G. Aminoff and B. Broomé.** *Zeits. f. Krist.* 91. *pp*. 77–94. *July*, 1935.—Description of apparatus and its use for obtaining powder photographs (transmission and reflection) of single crystals. The thickness of the single crystals needs to be of the order 10^{-5} cm. F. I. G. R.

***2829. Laue Chamber and Accessory Reflex-Net. E. Schmid.** *Zeits. f. Krist.* 91. *pp*. 95–96, *July*, 1935.—With metals, the large angle of deviation usually adopted leads to very long exposures. A smaller angle (45-150°) and the X-ray beam inclined to the crystal reduces the exposures considerably. The film is placed parallel to the primary ray. The net, originally intended for a film distance of 20 mm., is illustrated. F. I. G. R.

See also Abstracts 2869, 2965, 3021, 3071, 3104, 3150, 3177, 3182, 3188.

DENSITY.

See Abstract 3110.

DIFFUSION AND OSMOSIS.

2830. Diffusion Effect Upon Ionic Distribution. Part I. Theoretical. T. Teorell. *Nat. Acad. Sci., Proc.* 21. *pp.* 152–161, *March* 15, 1935.—Discussion of diffusion through membranes permeable to ions and its bearing upon the Donnan equilibrium. A. S. C. L.

See also Abstract 3199.

ELASTICITY AND PLASTICITY.

2831. Atomistic Theory of Compressibility. J. A. Wasastjerna. *Soc. Scien. Fennica, Acta & Comm. Phys. Math.* 8. 8. [15 *pp.*], 1935.—The earlier deductions of the author based on wave-mechanical considerations [see Abstracts 2798, 2800 (1933)] with respect to an expression for the repulsion potential which arises from the interaction between the electronic systems of ions, lead to definite values for the compressibility coefficients of the alkali halides, which are found to be in agreement with the experimental data. For salts which contain an ion from an element either at the beginning or at the end of the periodic system, the theory leads, however, to somewhat too low or too high compressibilities respectively. It is shown that a consideration of the approximations on which the potential functions are based will enable these deviations to be anticipated. The temperature and pressure coefficients of the compressibilities are also theoretically evaluated and found to be in excellent agreement with the experimental data. H. H. Ho.

2832. Elastic Constants of the Alkali Halides. J. A. Wasastjerna. *Soc. Scien. Fennica, Acta & Comm. Phys.-Math.* 8. 9. [9 *pp.*], 1935.—The connection between the compressibility, density, and elasticity constants is explained on the assumption that the repulsion potential $\psi kk'(r)$ is $\neq 0$ only for coordinated ions. The constant C_{12} has the character of a structural constant, which can be calculated from the lattice interval without any knowledge of the compressibility or of the analytical form of the repulsive force acting between the ions. From the compressibility and density, the ratio C_{11}/C_{12} may be calculated and it depends in a simple manner directly on the form of the potential function. The values of C_{11}/C_{12} satisfy the author's formula for the repulsion potential. H. H. Ho.

2833. Theory of Photoelasticity in Amorphous Solids. H. Mueller. *Physics*, 6. *pp.* 179–184, *June*, 1935.—The photoelastic effect in amorphous solids is caused by two effects. The elastic deformations alter the Lorentz-Lorenz interaction between the dipoles, and in addition produce optical anisotropy of the atoms. For pressure the first effect creates positive birefringence, while the second effect gives negative birefringence. In most cases the second effect is larger. With increasing index of refraction the first effect increases faster than the second effect, and hence the photoelastic constants decrease and reversal of sign occurs. Measurements on glasses verify the theory. A uniform volume expansion of 1 % increases the refraction of the oxygen ions by 0·4 % and a strain of 1 % creates an optical anisotropy of the O ion of about 0·7 %. For the positive ions these effects are somewhat smaller. AUTHOR.

2834. Wave Propagation in a Semi-Infinite Beam. S. Higuchi. *Tohoku Univ., Sci. Reports,* 23. *pp.* 835–845, *March,* 1935. *In English.*—Discusses the problem of a vibrating semi-infinite elastic beam, initially at rest, the finite end of which is subject to a forced simple harmonic motion. A. J. McC.

***2835. Dynamical Applications of Liquid Manometers. R. M. Sutton.** *Am. Phys. Teacher,* 3. *pp.* 77–81, *May,* 1935.—Adaptations of manometers to measure horizontal acceleration, vertical acceleration, centrifugal force and speed of rotation, and angular acceleration are described. Wheatstone's bridge connection renders the manometers electrically recording. AUTHOR.

See also Abstracts 2847, 2873, 2942, 3109.

GRAVITATION.

***2836. Torsion Balance Experiments in Gravitation and Magnetism. A. O. Rankine.** *Roy. Inst., Proc.* [9 *pp.*], *Advance copy received May* 14, 1935.—A non-technical account is given of some experiments with the Eötvös gravity torsion balance, demonstrating its high sensitivity. Experiments are also described having as their object the measurement of very small magnetic forces by means of an instrument also constructed on the torsion balance principle. G. C. McV.

HYDRODYNAMICS AND AERODYNAMICS.

2837. Transformations of Energy of a Gas Flowing in a Tube. A. Castagna. *Accad. Sci. Torino, Atti,* 70. 2. *pp.* 284–317, 1934–1935. In relation to the problem of the compression by inertia of fluids with hyperacoustic velocity, fundamental in propulsion with reaction, there is given a study of some properties of the motion of a fluid within a conduit and the suitable dimensions of this are found. The results of numerous experiments show that such compression is realised with considerable efficiency. J. J. S.

2838. Burgers's Theory of Turbulence. G. F. P. Trubridge. *Phys. Soc., Reports, pp.* 43–62, 1934.

2839. Instability of a Cylindrical Thread of a Viscous Liquid Surrounded by another Viscous Fluid. S. Tomotika. *Roy. Soc., Proc.* 150*A*. *pp.* 322–337, *June* 1, 1935.—The instability of a long cylindrical thread of a viscous liquid of viscosity μ^1 in an infinite mass of another viscous liquid of viscosity μ under the action of interfacial surface tension as well as of viscous forces is considered by the method of small oscillations, the motions being supposed symmetrical about the axis of the column and proportional to e^{qt} as well as to e^{ikz}, where z is taken along the axis of the thread [see Taylor, Abstract 4397 (1934)]. When the ratio $\mu^1 : \mu$ takes finite values, the maximum instability, *i.e.*, the maximum value of q always occurs at a certain definite value of the wave-length of the varicosity indicating that drops of definite size would be formed, and this wave-length varies with $\mu^1 : \mu$. The wave-length of the varicosity corresponding with the maximum instability increases indefinitely as the ratio $\mu^1 : \mu$ tends towards infinity or zero. Comparison of the theoretical considerations with Taylor's observation shows good agreement. T. H. P.

See also Abstract 3123.

KINETIC THEORY OF MATTER.

2840. Radiometer Force and Dimensions of Apparatus. R. E. H. Rasmussen. *Ann. d. Physik,* 22. 7. *pp.* 643–656, *May,* 1935.—The radiometer force is dependent upon the gas pressure, the temperature differences, and the geometrical proportions of the apparatus. Measurements were made of the radiometer force on platinum bands blackened on one side, and tests were made to find how this force varied with the width of the band and the size of the container in which the band was placed. The methods of measurement of the radiometer forces were the same as those of M. Knudsen [see Abstract 194 (1931)]. Indicating by R_1 the radiometer force on 1 cm. of the length of a Pt band if the temperature of the band is T_1^0 higher than that of the surrounding enclosure, the following facts were observed: (1) R_1 is approximately proportional to T_1; (2) the magnitude R_1/T_1 is at low pressures proportional to the breadth of band B; (3) the maximum value R_{1m}/T_1 changes only slightly with B if the surrounding enclosure is large; (4) for the same value of B but with enclosure diminished in size R_{1m}/T_1 increases; (5) the pressure p_m at which R_{1m}/T_1 appears, is in a large enclosure nearly inversely proportional to B; (6) with B kept constant p_m increases if the enclosure is made smaller; (7) with high pressures in a large enclosure R_1/T_1 decreases strongly with increasing B; there is thus no question of edge action.

J. J. S.

2841. Theory of the Brownian Movement. G. Krutkow and V. A. Dmitrijev. *Comptes Rendus de l'Accad. des Sciences, U.S.S.R.* 1. *pp.* 603–605, *March* 21, 1935. *In German.*—In three previous publications [see Abstract 591 (1935)] a general method has been developed for the solution of linear problems in the theory of the Brownian movement, and in the present paper this method is applied to the case of a system of *n* degrees of freedom which can perform small oscillations. The paper is entirely mathematical. H. H. Ho.

2842. Observation of Brownian Motion with the Unaided Eye. J. Obrist. *Phys. Zeits.* 36. *pp.* 343–344, *May* 1, 1935.—For observing Brownian motion with the unaided eye, suspensions rich in particles, which should not be too small, are necessary. The requirements are not the same as for ultra-microscopic observation, and a number of suitable preparations are described. W. S. S.

See also Abstracts 3100, 3101.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

2843. Light-Waves as Units of Length. W. E. Williams. *Nature,* 135. *p.* 917, *June* 1, 1935.—A correction. The mean value of the wave-length of the red cadmium line in normal air given in the former article [see Abstract 1971 (1935)] should be $6438{\cdot}4691 \times 10^{-10}$ m., and not $6438{\cdot}4687 \times 10^{-10}$ m.

2844. Application of the Thermionic Valve to the Measurement of Physical Quantities. F. de la C. Chard. *Journ. Sci. Instruments,* 12. *pp.* 191–194, *June,* 1935.—A valve oscillator with tuned-grid and tuned-anode circuits is described in which a moving plate system causes an increase in anode-circuit capacitance simultaneously, with a decrease in grid-anode capacitance. The initial capacitance values may be chosen to make the accompanying variation of the anode current linear between wide limits and highly sensitive to these changes in capacitance. The device finds application in extensometry as length changes of less than one micro-in. may be detected with a recorder. T. I. J.

MATHEMATICAL METHODS, THEORY OF MEASUREMENTS, UNITS AND DIMENSIONS.

2845. Evaluation of the Heaviside Operational Expression by Fourier Series. S. Koizumi. *Phil. Mag.* 19. *pp.* 1061–1076, *June*, 1935.—In the preceding articles [see Abstract 2452 (1931)] have been shown the theoretical ground and the practical calculation of the author's Fourier-series evaluation which consist in the calculation of Fourier coefficients from the given Heaviside operational expression in order to evaluate its explicit function in the range from $t = 0$ to some other arbitrary but fixed value of t. Since Fourier coefficients can be obtained here from the given operational expression by the mere algebraic calculation of complex numbers, this method will always be practicable, even if the other methods fail in the evaluation of the explicit function. In the present paper only simple examples are adopted to illustrate the author's method of evaluation in cases where $f(o) = 0$, $f(o) =$ a finite number, and $f(o) = \infty$. It is intended that physical and technical applications of this method will be shown in future. AUTHOR.

See also Abstracts 2952, 3143.

MECHANICS, CLASSICAL.

2846. Geometry of the Masses of Circular Sectors. G. Merlo. *N. Cimento*, 12. *pp.* 76–80, *Feb.*, 1935.—Details are given of a construction of the centre of oscillation for homogeneous circular sectors. J. J. S.

2847. Mechanics of Deformable Bodies. K. Weissenberg. *Arch. des Sciences*, 17. *pp.* 44–106, *Jan.–Feb., and pp.* 130–171, *March–April*, 1935.—The deformation is defined by kinematic variables, the exterior forces by dynamic variables. The purpose is to establish the relations between these. Ideal bodies are set up in which the element of volume has 12 degrees of liberty, 6 being rigid displacement, 6 deformation. An introductory section enunciates the fundamental principles, d'Alembert's and the equation of state, and the simplifying assumptions, initial isotropy, incompressibility, constant temperature. An Appendix develops fully the necessary algebra of second-order tensors. This is applied to a rigorous treatment of the linear kinematics of the element of volume. The corresponding dynamics and relations between the variables are then taken up. The thermodynamic theory is developed from the defined equation of state. The most important features of the mechanics of the body in a state of strain can then be developed; they lead to a theorem of anisotropy. T. L. M.

2848. Fields in Mechanics. U. Weyer. *Zeits. f. Physik*, 94. 7–8. *pp.* 496–503, *April* 8, 1935.—The field-theory of electromagnetism is transposed into mechanics. The necessary abstractions involved are not found to be more difficult than in the case of electromagnetism. H. L. B.

***2849. Electrostatic Pendulum. J. A. van den Akker.** *Am. Phys. Teacher*, 3. *pp.* 72–74, *May*, 1935.—Energy is imparted to the pendulum by electrical forces alone. The bob, which may be rectangular, swings between a pair of vertical, parallel plates, the plates and bob being connected permanently to a condenser of small capacitance, C. The condenser is charged continuously through a high resistance, R by a battery or simple rectifier furnishing a p.d. V_0 e.s.u., and is discharged when an electrode on the pendulum sweeps over a mercury cup (or gap electrode) at the neutral position. For moderate amplitudes the restoring force during an inward swing is much greater than the retarding force during an outward swing, if $RC = 0\cdot13\ T$, where T is the period. For amplitudes A less than the width of the bob and plate, the oscillation is sustained if $V_0 = (4\pi^3 kAd/0\cdot653bT)^{\frac{1}{2}}$, where k is the viscous damping force per unit speed, d is the distance between the bob and either plate, and b is the height of the bob. Modification of the arrangement for the Foucault pendulum is suggested. AUTHOR.

See also Abstract 2835.

MECHANICS, QUANTUM.

2850. Quantum and Wave Mechanics. G. Temple. *Phys. Soc., Reports, pp.* 1–23, 1934.

2851. Method of Perturbations in Wave Mechanics. C. W. Oseen. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*A. No.* 2. *pp.* 1–13, 1935. *In French.*—It is shown that the accepted wave-mechanical theory of the Stark effect in which the effect of the external electric field is represented by a term eFz in the potential function of the wave equation which is then solved by the method of perturbations, is mathematically unsound. The lines along which a rigorous theory could be obtained are indicated. It is not expected that the eigenenergies given by Epstein, Schrödinger and others will be modified, but the intensities of the Stark components will be found to depend on a parameter representing the extent of the electric field. An explanation of the variation of Stark intensities with the conditions of excitation may then be obtained. In a second part the Heitler and London theory of homopolar combination is shown to depend on the validity of a certain step in the analysis for which no proof has so far been put forward. W. S. S.

2852. Schrödinger's Operator S. R. L. Gomes. *Accad. Lincei, Atti,* 21. *pp.* 179–186, *Feb.* 3, 1935.—It is well-known that if H, the Hamiltonian operator, is independent of the time, then the solution of Schrödinger's equation, $(h/2\pi i)d\psi/dt + \mathrm{H}\psi = 0$, which reduces to ψ_0 initially is equal to $e^{-(2\pi i/h)\mathrm{H}t}\psi_0$. The present paper generalises this result by proving that in the general case if the operator S satisfies the equations $d\mathrm{S}/dt = \mathrm{H}$, $\mathrm{HS} - \mathrm{SH} = 0$, then $e^{-(2\pi i/h)\mathrm{S}}\phi$, where ϕ is independent of t, is a solution of Schrödinger's equation. The author deduces from this result a general expression for the solution of Schrödinger's equation which reduces to ψ_0 initially, and is able to apply his results to give simple proofs of some well-known properties of the solutions of this equation. A. J. McC.

2853. Approximate Adaptation of a Solution of the Schrödinger Equation to the Solution of the Dirac Equation. A. Sommerfeld and A. W. Maue. *Ann. d. Physik,* 22. 7. *pp.* 629–642, *May,* 1935.—It is pointed out that the second-order Dirac equation for the electron is soluble by approximation by means of a series in powers of the fine-structure constant, the first term of the series being a solution of the Schrödinger equation. The subsequent terms are calculable from the first. It is also shown that an arbitrary function can be expanded in terms of the eigenfunctions of the Schrödinger solution. The method is applied to the problem of the motion of a plane electron wave in the Coulomb field of an atomic nucleus. G. C. McV.

2854. Exact Solution of Dirac's Equation for a Plane Wave of Determined Frequency. D. M. Volkov. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 605–610, *March* 21, 1935. *In French.*—The general solution is given by the expression $\int c(p) \cdot \psi p \cdot dp$, the integral being considered as the triple $dp = dp_1\, dp_2\, dp_3$, and $c(p)$ as an arbitrary matrix determined by the condition of existence of the integral in the case where the region of integration is not finite. H. H. Ho.

2855. Eigenvalues in One-Dimensional Periodic Fields of Force. H. A. Kramers. *Physica,* 2. *pp.* 483–490, *May,* 1935. *In German.*—The eigenvalues for the wave-function in Schrödinger's equation for one dimension with a periodic field of force are worked out by a simplified method. G. C. McV.

2856. Waves, Spin, and Integers. E. Sevin. *Comptes Rendus,* 200. *pp.* 1744–1746, *May* 20, 1935.—Previous investigations [see Abstract 1453 (1935)] are extended to the case of the fundamental orbit of the neutron, the term V being taken as equal to the velocity of light, and the terms e/V and c^2/V^2 equal to unity. It is shown that the stable state corresponding to the neutron is realised when the total apparent energy of the particle is eliminated in passing from a positive to a negative value, and the magnitude of the kinetic moment e^2/V reaches its minimum value. On equating the kinetic moment of hydrogen, $nh/2\pi$, to that of the neutron e^2/c we have $n = 1/137$. It is also shown that the neutron appears as an intimate union of an electron and a proton, the separation distance of the two particles being less than the classical radius of the electron, and the binding energy being given by $0 \cdot 923\, m_0c^2$. If $1 \cdot 00756$ is taken as the mass of H, that of the neutron in its fundamental orbit is $1 \cdot 00706$, but the neutron may, outside this orbit, absorb energy which allows it to manifest itself with appreciably greater mass. N. M. B.

2857. Propagation of Waves in Wave Mechanics. Elastic Waves. L. Brillouin. *J. de Physique et le Radium,* 6. *pp.* 185–193, *May,* 1935.—The problem of wave quantisation is rigorously investigated for elastic waves. Using Waller's generalised coordinates the quantisation is related to that of a degenerate harmonic oscillator of two dimensions, for which there is a conservation of moment of rotation which is translated as conservation of sense of propagation of free waves. This oscillator is treated generally; the form of the wave functions is indicated for any number of dimensions, and the waves are completely described for two dimensions, together with the chief matrices. Results are related to the theory of specific heats and electrical resistance, and the theory of thermal conductivity of insulators, and to electromagnetic waves. [See following Abstract.] N. M. B.

2858. Transverse Physical Waves in Wave Mechanics, and the Harmonic Oscillator in Four Dimensions. L. Brillouin. *Comptes Rendus,* 200. *pp.* 1725–1728, *May* 20, 1935.—In a previous paper [see preceding Abstract] the introduction of separated variables relates the problem of the propagation of waves in wave mechanics to that of a degenerate harmonic oscillator in two or four dimensions, the longitudinal waves corresponding to an oscillator in two dimensions, and the transverse waves in an isotropic medium leading to an oscillator in four dimensions. The conservation of the moment of rotation of the oscillator expresses the conservation of sense of wave propagation and also its type of rotatory polarisation, the quantisation of the angular variables involving that of the polarisation. From the four coordinates of such an oscillator the wave functions are formed by various equivalent methods. Each type of function can be expressed by a linear combination of functions, and expresses the possibility of decomposing stationary waves into waves of propagation, or linearly polarised waves into circular waves. Matrices for the longitudinal waves are calculated. N. M. B.

2859. General Relativistic Quantum Mechanics. Part II. Cosmological Phenomena. H. Jehle. *Zeits. f. Physik,* 94. 11–12. *pp.* 692–706, *May* 3, 1935.—In continuation of previous work [see Abstract 961 (1934)] the application of wave mechanics to gravitational phenomena is shown to afford a relatively simple explanation of the structure of the spiral nebulae and spherical star clusters. J. S. G. T.

2860. Relativistic Quantum Mechanics. K. Nikolsky. *Roy. Soc., Proc.* 150*A*. *pp.* 411–415, *June* 1, 1935.—This paper contains a development of the field theory. It is here obtained by pure deduction, employing only affine geometry, and the fundamental equations of the relativistic quantum theory. The connection between Dirac's theory of electrons and the Eddington-Born-Infeld theory is obtained. AUTHOR.

2861. Relativistic Basis of Quantum Theory. Part III. H. T. Flint. *Roy. Soc., Proc.* 150*A*. *pp.* 421–441, *June* 1, 1935.—The paths of electric charges are considered as particular geodesics in a five-dimensional continuum, and values of the coefficients in the expression for the line element are determined for these particular tracks. By the introduction of the idea of a matrix length, combined with parallel displacement, the first-order quantum equations are developed. By squaring this length we obtain the square of the length occurring in the theory of relativity and find a modification of the curvature expression. A new vector occurs which has the properties of de Donder's and Rosenfeld's internal tension. The conclusion is that quantum phenomena correspond to geometrical conceptions which may be said to underlie those of the theory of relativity, the complete geometrical scheme including the quantum theory, gravitation and electromagnetism. [For Part II see Abstract 3155 (1934).] AUTHOR.

2862. Electromagnetic Fields of the Quantum Theory. Part III. L. Goldstein. *J. de Physique et le Radium,* 6. *pp.* 209–214, *May,* 1935.—Static fields are investigated in order to establish the spatial limits within which the law of a field due to a source can be verified by measurements, and to fix the conditions for which the classical form of the law relative to points can be justified. In the first case the method of measurement of the diffusion of test bodies in the fields created by the centres is employed. The comparative limit of validity of classical theory is determined by the ratio d/λ, where d is the classical minimum distance of approach of the test body to the field source, and λ is the de Broglie wave-length associated with the test body. If $d/\lambda < 1$, only conclusions in conformity with quantum mechanics are admissible. It is found that in Coulomb-type fields the ratio is precisely the parameter of series development of Born's method of successive approximations. The classical point laws can be justified for uniform fields and in non-uniform fields varying relatively slowly over distances of the order of linear dimensions of the test body. [For Part II see Abstract 601 (1935).] N. M. B.

2863. Electromagnetic Mass of the Dirac Electron. N. Kemmer. *Ann. d. Physik,* 22. 7. *pp.* 674–712, *May,* 1935.—The significance of electromagnetic mass in the case of the Dirac electron is discussed, and expressions are derived for its longitudinal and transverse mass. The logarithm of the electronic radius enters into the latter expression.

J. S. G. T.

See also Abstracts 2779, 2797, 2831, 2838, 3013, 3107, 3152, 3186.

RELATIVITY AND ETHER.

2864. Born's New Field Theory. E. Schrödinger. *Roy. Soc., Proc.* 150*A*. *pp*. 465–477, *June* 1, 1935.—A new representation of Born's field theory [see Abstract 1875 (1934)] by complex six-vectors is dealt with, so far only from the classical point of view, without entering into the question of quantisation. The ostensibly simple form of the Lagrangian and of the components of the energy-tensor is remarkable, all these quantities being rational and homogeneous functions (of degree zero) of the components of the field. The following points are considered : (1) In addition to the Lorentz transformation a one-parameter-transformation of the field exists (called γ-transformation in this paper), under which the field equations are invariant. (2) The theory points to a strong dissymmetry between field and displacement, but to none between electricity and magnetism. The only means of accounting for the latter dissymmetry (actually met with in nature) on the present theory seems to be to make use of the former. (3) The form of the equations emphasises the extremely singular character of the case in which electric and magnetic field are equal and perpendicular to each other. (4) The complete symmetry between " normal " and " abnormal " fields is thrown into relief, recalling strongly the so-called positive and negative solutions in Dirac's theory of the electron. AUTHOR.

2865. Gravitational and Electromagnetic Mass in the Born-Infeld Electrodynamics. B. Hoffmann. *Phys. Rev.* 47. *pp*. 877–880, *June* 1, 1935.—By postulating that infinite relativistic gravitational potentials are to be rejected in the Born-Infeld theory, it is shown that the gravitational mass of an electron becomes equal to its electromagnetic mass, and that difficulties in the usual relativistic treatment of gravitational mass are avoided. The above postulate is extended and its bearing on the alternative sets of field equations of the Born theory, and on a proposal made by the author is discussed. AUTHOR.

See also Abstracts 2859, 2860, 2861, 2885, 2969.

SOLUTION.

2866. Experimental Tests of a General Equation for Solubility. J. H. Hildebrand. *Am. Chem. Soc., J.* 57. *pp*. 866–871, *May*, 1935.—An equation for the calculation of the solubility from the properties of the pure components has been tested for a large number of solutions of iodine, stannic iodide, sulphur and phosphorus and found to hold even better than could be expected in view of the approximations involved. Departure from spherical symmetry and presence of dipole moment do not necessarily vitiate the calculations. The uncertainty on the basis of the London theory regarding the relation between the attraction constants of like and unlike molecules, $k_{12} \leqq (k_{11}\, k_{22})^{\frac{1}{2}}$, seems to be greatly diminished by experimental indications that the inequality is small. AUTHOR.

***2867. Solubility of Lead in Mercury. H. E. Thompson, Jr.** *J. Phys. Chem.* 39. *pp*. 655–664, *May*, 1935.—Special solubility apparatus has been designed and special experimental technique developed for the efficient handling of the rapidly oxidised lead amalgams. This type of apparatus and technique may be of use also in studies of other easily oxidised amalgams. About seventy determinations of the solubility of lead in mercury have been made in the temperature range 20° C. to 70° C., with an average deviation of about 5 parts per 1000 for the final runs. The experimental results are adequately represented by the following equation within the temperature range studied: $N_{Pb} = 0 \cdot 5893 - 0 \cdot 004115T + 0 \cdot 000007354T^2$. AUTHOR.

2868. Solubility of Helium in Water. R. Wiebe and V. L. Gaddy. *Am. Chem. Soc., J.* 57. *pp.* 847–851, *May,* 1935.—The solubility of helium was measured at 0, 25, 50 and 75° from 25 to 1000 atmospheres partial pressures. The calculated Bunsen and Ostwald absorption coefficients showed excellent agreement with the best known values. Like hydrogen and nitrogen, helium also shows a minimum of solubility, though at a lower temperature. AUTHORS.

See also Abstracts 3087, 3102, 3109.

SURFACE TENSION AND COHESION.

2869. Metallic Bond. P. Gombás. *Zeits. f. Physik,* 94. 7–8. *pp.* 473–488, *April* 8, 1935.—Herzfeld's view of the binding force in metals, used by Bomke [see Abstract 4891 (1934)] is applied in energy calculations on alkali metals which crystallise in a space-centred lattice. It is assumed that the binding energy in the metal is supplied by the electrostatic action of the positive ion-lattice and the uniformly distributed gas of metal electrons, and by the interchange energy of this electron gas. The energy of repulsion is taken as the null point energy of the gas. Energy is also taken into account which is derived from the penetration of the gas into the electron clouds of the ions, and from the mutual screening by electron clouds of neighbouring ions. With K as an example, it is shown that these assumptions lead to results which agree with experimental values (given in brackets), namely, lattice constant, 4·52 Å (5·15 Å); heat of sublimation, 20·8 k.cal./mol. (26·5 k.cal./mol.); compressibility, $1 \cdot 1 \times 10^{-11}$ cm.^{2}/dyne ($2 \cdot 0 \times 10^{-11}$ cm.^{2}/dyne). G. E. A.

2870. Classical Physics: Surface Tension. A. Ferguson. *Phys. Soc., Reports, pp.* 30–42, 1934.

2871. Surface Tension of a Moving Water Sheet. W. N. Bond. *Phys. Soc., Proc.* 47. *pp.* 549–558, *July,* 1935.—The direct impact of two cylindrical jets of liquid causes the liquid to emerge radially in a plane at right angles to the common axis of the jets. The maximum diameter of the disc of moving liquid so formed is shown to depend on the surface tension of the liquid. A method of measuring surface tension is developed and is applied to measure the surface tension of water giving $73 \cdot 8_3 \pm 0 \cdot 1_3$ dynes/cm. at 15° C. The liquid surface is renewed about 80 times per sec., contamination being thus prevented. The only other method in which such rapid renewal of the surface takes place is the Rayleigh oscillating-jet method. The angle of contact is not involved in Rayleigh's method, nor in the present method. AUTHOR.

2872. Surface Tension of the System Sulphuric Acid-Water. L. Sabinina and L. Terpugow. *Zeits. f. phys. Chem.* 173. *Abt.A.* 3. *pp.* 237–241, 1935.—Measurements have been made of the surface tension of the system sulphuric acid-water, at 10°, 20°, 30°, 40° and 50° C., and the temperature coefficient found to show a definite minimum at 33 mol.

per cent acid which corresponds to the compound $H_2SO_4 \cdot 2H_2O$. Deviations from additive values of the surface tension are computed, the maximum value at all the temperatures investigated being at 33 mol. per cent acid. The presence of two other compounds indicated on the melting-point diagram is not confirmed either by the surface tension isotherms, or by the temperature coefficients or by the deviation curves. H. H. Ho.

2873. Relation of Surface Tension to other Physical Properties of Liquid Mixtures. R. M. Conrad and J. L. Hall. *Am. Chem. Soc., J.* 57. *pp.* 863–866, *May*, 1935.—In the system, chloroform-methanol, close correlation was found between surface tension and compressibility, both being nearly ideal functions of composition. Vapour pressure data deviated widely from the ideal. The system does not conform to Worley's rule of the antibatic relation between surface tension and vapour pressure. AUTHORS.

***2874. Displacement of Electrocapillary Curve with Concentration and Temperature. L. A. Hansen and J. W. Williams.** *J. Phys. Chem.* 39. *pp.* 439–453, *April*, 1935.—With a modified Lippmann electrometer electrocapillary curves were obtained for 1·0, 0·2 and 0·02 molar aqueous ammonium nitrate solutions at the temperatures 25°, 50° and 75° C. The position of the maximum in each curve was located by means of an analytical procedure. An explanation based upon the capillary activity of the ammonium nitrate has been presented for the displacement of these curves toward lower values of interfacial tension with increase in temperature and with increase in concentration. A displacement of the maxima of the curves toward lower values of applied potential at the higher temperatures has been partially accounted for on the basis of a decreased adsorption of anions and an increased tendency toward random distribution of solvent dipoles caused by the rise in temperature. AUTHORS.

2875. Drop-Weight Method for the Determination of Electrocapillary Curves. S. R. Craxford and H. A. C. McKay. *J. Phys. Chem.* 39. *pp.* 545–550, *April*, 1935.—A technique for the determination of electrocapillary curves by the drop-weight method has been developed, and the resulting curves are shown to coincide to within 0·2 per cent with the corresponding curves obtained in the usual way with a capillary electrometer. AUTHORS.

***2876. Direct Record of Variations of Surface Tension with Time and Area in Monomolecular Films. D. G. Dervichian.** *J. de Physique et le Radium*, 6. *pp.* 221–225, *May*, 1935.—For variations of surface tension with time an adaptation of Wilhelmy's method is used. A thin vertical slip of glass, A, hung from one beam of a light balance is partially submerged in the liquid under examination; to the other is hung an Al rod terminating in a horizontal disc and plunged in vaseline oil. Changes in surface tension from a preliminary equilibrium position cause A to move up and down, and so rotate a mirror attached to the centre of the beam of the balance, light reflected from which is thrown on to photographic paper on a rotating cylinder. For variations with area the barrier float of a Langmuir trough is connected with the recording cylinder and both moved by an electric motor, while the surface tension changes move A. C. A. S.

See also Abstracts 2806, 2922.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

2877. Apparent Lunar Effect in Time Determinations. A. L. Loomis and H. T. Stetson. *Roy. Astron. Soc., M.N.* 95. *pp.* 452–466, *March,* 1935.—The evidence for a small apparent change in longitude with changes in the moon's position [see Abstract 3381 (1933)] is strengthened by a further investigation in which the Paris (Bordeaux) signals have been used as well as those of Greenwich and Washington. No trace is found of the effect as between Greenwich and Paris; but both transatlantic comparisons show it clearly. A possible explanation is a very small displacement of the observer's meridian, implying slight periodic changes in the geographical coordinates of the observatories involved. There is also evidence of a small seasonal term. T. L. M.

VACUA, HIGH.

2878. Temperature Coefficient of Hot-Wire Vacuum Meters and Vacuum Thermocouples. E. Kobel. *Assoc. Suisse Élect., Bull.* 26. *pp.* 196–199, *April* 12, 1935.—It is pointed out that in hot-wire vacuum meters, as well as thermocouples in vacua, the change in temperature of the element is less than the change in temperature which may be experienced by surrounding vessels. As an example, the temperature coefficient of a certain vacuum meter was found to be 0·35 mV/°C, corresponding to an error of 5 % for a temperature change of 10° C. The temperature coefficient may be reduced by blackening neighbouring reflecting surfaces; in the particular case cited the coefficient was reduced to 0·24 mV/°C. G. E. B.

VISCOSITY, FRICTION AND LUBRICATION.

2879. Viscosity of Deuterium. I. Amdur. *Am. Chem. Soc., J.* 57. *pp.* 588–589, *March,* 1935.—The viscosity of a deuterium-hydrogen mixture ($D_2 : DH : H_2 = 81 : 18 : 1$) was measured by a capillary flowmeter using Apiezon oil as manometric liquid; the observed viscosity ratio deuterium-hydrogen for this mixture was 1·334, the calculated ratio being 1·375. It is inferred that pure deuterium has a viscosity $\sqrt{2}$ times that of hydrogen in conformity with gas-kinetic prediction. L. V. C.

2880. Temperature Variation of Viscosity of Aqueous Solutions of Strong Electrolytes. W. J. Sulston. *Phys. Soc., Proc.* 47. *pp.* 657–666, *July,* 1935.—The viscosity of aqueous solutions of KCl and of K_2SO_4 has been measured over a wide range of temperature. Every care has been taken to eliminate, or to correct for, sources of error. The results have been analysed by plotting $(\phi/\phi_0 - 1)/\sqrt{c}$ against $\sqrt{c}$, and in those cases where the relation between these variables proved to be linear the value of A and B in the equation $\phi/\phi_0 = 1 + A\sqrt{c} + Bc$ at each temperature have been calculated. AUTHOR.

2881. Viscosity Formula for Binary Mixtures. T. Ishikawa and T. Baba. *Chem. Soc., Japan, Bull.* 10. *pp.* 153–167, *April,* 1935. *In English.*—From an experimental investigation of aqueous solutions of alkali chlorides and nitrates it is concluded that negative viscosity, when observed, is entirely due to the smaller solutional viscosity of the solute than the viscosity of water, but not to the ionic behaviours suggested by other investigators. The viscosity formula formerly proposed and developed by Ishikawa [see also Abstract 2777 (1934)] for a binary mixture of liquids proves to have a general applicability in this new field of aqueous solutions of electrolytes, and at the same time, to play an important rôle in finding their hydrates in solution. H. H. Ho.

See also Abstracts 2922, 3112.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***2882. Extinction Method in Photometry of Just-Visible Astronomical Objects. A. Markov.** *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 449–451, *March* 11, 1935. *English Abstract.*—Laboratory experiments and a comparison of the results of previous observers show that extinction methods are the most suitable for measuring the brightness of the milky way, night sky, and the like, and also for faint variable stars with rapid fluctuations. The apparatus of Wawilow [see Abstract 4989 (1934)] is simple and accurate. Detailed tables appear in the Russian text. The author also gives precautions to be observed in applying the method to astronomy. T. L. M.

***2883. Zonal Zernike Test for Paraboloids. C. R. Burch.** *Roy. Astron. Soc., M.N.* 95. *pp.* 548–554, *April*, 1935.—The author finds that the Zernike phase-contrast test [see Abstracts 2366–7 (1934)] can be used for paraboloids of low asphericity by testing at the centre of curvature and taking zonal focal readings, in a manner very similar to the zonal knife-edge test. A comparison of the two methods is given. The author has also examined the limit of sensitivity of the test in the form employed by him and finds it identical with the limit predicted theoretically by Zernike. T. L. M.

***2884. Heliostat for Physics Laboratory. A. Adel.** *J.O.S.A.* 25. *p.* 195, *June*, 1935.—This arrangement was devised to combine large size and consequent precision driving with simplicity and convenience, and was intended for remote infra-red work. Focal length 100 feet; 9-in. front-silvered mirrors; drive suitable for two-hour exposures. T. L. M.

See also Abstract 2884.

COSMOGONY.

2885. Expanding Universe as a Thermodynamic System. E. A. Milne. *Manchester Lit. & Phil. Soc., Mem.* 78. *pp.* 9–40, 1933–1934.—A non-technical exposition is given of the author's kinematical relativity [see Abstracts 1347 and 1348 (1933)] which leads to a theory of the expanding universe not involving a " heat-death," since the law of increasing entropy is held not to apply to the universe as a whole. G. C. McV.

2886. Chemical Constitution of the Universe. M. Paul. *Gerlands Beitr. z. Geophys.* 44. 2. *pp.* 129–138, 1935.—The author assumes that building up and destruction of atomic nuclei takes place in the interior of stars. The frequency of each type of nucleus then depends on conditions in the star, which will move in the direction of maximum entropy. In general a star moves towards a condition in which a large part consists of nickel and iron. Hence an explanation of the earth's central mass and a possible method of finding the probability of different distributions of the individual elements in the earth's core. T. L. M.

See also Abstracts 2859, 2887.

LATITUDE AND LONGITUDE.

See Abstract 2877.

NEBULÆ.

2887. Spiral Nebulæ and Expansion of the Universe. G. C. McVittie. *Phys. Soc., Reports, pp.* 24–29, 1934.

See also Abstracts 2890, 3010, 3031.

STARS.

2888. Photographic Magnitudes of ζ Aurigæ During the 1934 Eclipse. P. T. Oosterhoff. *Mt. Wilson Observat., Contrib. No.* 518. *Astrophys. J.* 81. *pp.* 461–466, *June*, 1935.—Photographic magnitudes of ζ Aurigæ during the recent eclipse were derived from plates taken with the 10-inch refractor and Schraffierkassette. On the descending as well as on the ascending branch of the light-curve a set of observations was obtained. The epoch of minimum is found to be J.D. 2427692·70 ± 0·15 (M.E.). The interval between maximum and minimum light is of the order of 1·5 days. The inclination of the orbital plane remains uncertain. On the assumption of central eclipse the ratio between the diameters of the K- and B-type components would be 0·038. AUTHOR.

2889. New Theory of Star Motions. J. Schilt. *Nat. Acad. Sci., Proc.* 21. *pp.* 143–147, *March* 15, 1935.—The author starts from the velocity figure, in which each star is represented by a point whose coordinates are $\dot{X}$, $\dot{Y}$, $\dot{Z}$, and determines a plane such that the gradient of density of the star points is a maximum along the normal. The required $\dot{Z}$ direction is found in galactic longitude 50°. There are now two maxima of $\dot{Z}$, at −22 and 0 km./sec. (Hyades and UMa starts respectively). The present work is limited to the A stars. The material indicates a linear relation of $\dot{Z}$ to Z, about 5 km./sec. per 100 parsecs towards gal. long. 50°. Hence a formula for indirect parallaxes, the results of which are discussed. The hypothesis of an expansion of the stellar system, involved in these results, may be tested further. The author's data favour this as against the galactic rotation theory. T. L. M.

2890. Radial Velocities of Globular Clusters and Nebulæ. S. W. Shiveshwarkar. *Roy. Astron. Soc., M.N.* 95. *pp.* 555–558, *April*, 1935.—The author finds the elements of the solar motion with regard to 21 globular clusters. The K-term is very small. There is fair agreement with Strömberg's result for 18 of the same clusters. The velocity of the mean of the local stars with regard to the mean of these globular clusters is found. On correction for the solar motion so found the residual radial velocities of the nearer extra-galactic nebulæ are greater in the positive sense than the observed radial velocities. T. L. M.

2891. Variable Spectrum of γ Cassiopeiæ. W. J. S. Lockyer. *Roy. Astron. Soc., M.N.* 95. *pp.* 520–529, *April*, 1935.—The author has continued to photograph the spectrum at least twice per month; predictions have not been fulfilled. During 1933 the red components of the hydrogen lines continued to fade at the expense of the violet ones. In place of a reversal of this process, however, the red component disappeared completely, then the single violet component moved over to the red side (1934 March–November). In December 1934 a new violet component made its appearance and continued faint during the first months of 1935. This behaviour appears unique and inconsistent with current theory. [See Abstract 3973 (1933).] T. L. M.

2892. Behaviour of SiF Bands in Stellar Spectra. P. Swings. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 25. B. *No.* 2. *pp.* 1–6, 1935. *In English.*—Hitherto SiF has only been found in absorption in solar disc and spot spectra and the author investigates their appearance in different stellar spectra, especially the (O, O) band of the α system having a head at λ 4368·22, and the band heads at λ 4398·26 and λ 4334·35. He compares with these, spectra (taken at Stockholm with the 40-in. Grubb and a 3-prism combination giving a dispersion of 6 Å/mm at λ 4200) of the sun, γ Cygni, η Pegasi, β Aquilæ, α Cassiopeiæ, α Boötis, 40 Lyncis and α Orionis. The SiF bands appear on all these plates, and behave in the same way. The band strengths increase continuously with spectral type (but little can be told about the absolute magnitude effect); the number of SiF molecules increases continuously from GO to M, but this increase is slower than in the case of the TiO molecules. The author compares his results with H. N. Russell's theoretical behaviour of the TiO bands [see Abstract 1509 (1934)], translating his temperature figures into spectral types by means of a diagram. The abundance of F is of the same order in all the stars examined. A. S. D. M.

2893. Stark Effect in Hydrogen in First-Type Stellar Spectra. A. Pannekoek and S. Verwey. *K. Akad. Amsterdam, Proc.* 38. 5. *pp.* 479–489, 1935.—Struve attributed H-line broadening in type A stellar spectra to Stark effect in stellar atmospheres where H atoms are subjected to electric fields due to positive ions and negative electrons resulting from ionisation. Intensity distributions in stellar H absorption lines with Stark effect, Doppler effect and resonance damping are calculated for various conditions of surface gravity, temperature, etc., and results are given in tables and diagrams. The Stark effect gives a complete quantitative explanation of broad H lines in hotter stars. Increase of line-width with gravity is important for recognition of white dwarfs and for determination of surface gravity of any white star with strong H lines. In white dwarfs Hα and Hγ should have narrow dark centres, and Hβ and Hδ narrow bright centres, against adjacent parts of the wings of the lines. W. J.

2894. Interpretation of the Hydrogen Absorption Continuum in First-Type Stellar Spectra. D. Barbier, D. Chalonge and É. Vassy. *Comptes Rendus,* 200. *pp.* 1730–1732, *May* 20, 1935.—For the continuum between λ 3000 and λ 4500 in such spectra the authors represented the optical density D_λ, i.e., the difference of log intensities emitted at λ by a black body at the effective stellar temperature T_e and at the surface temperature T_0, by $D_\lambda = D_{3700} + p\,(3700-\lambda)$ [see Abstract 1497 (1935)]. Arguing from this result they deny that the continuous absorption takes place either (*a*) entirely inside, or (*b*) entirely outside the stellar photosphere, and assert that Yü's photometric measurements, which have previously been accepted as supporting (*b*), lead to too low values of D_{3700}. The authors regard the hydrogen continuum as being produced partly in the stellar atmosphere and partly in the nebular envelope and give reasons for and consequences of this hypothesis. W. J.

2895. Hydrogen Emission Lines of Long-Period Variables. G. Shajn. *Zeits. f. Astrophysik,* 10. *pp.* 73–85, *May* 12, 1935.—In emission-line long-period variables of types M, S, N, and R, the relative intensities of the Balmer lines present complex unsolved problems. The present paper relates these to the distribution and intensity of molecular bands present. The Me stars show a general decrease of the ratio of

$H\gamma$ to *$H\delta$* from MOe to M8e. This is shown to be related to the rapid changes of intensity of the TiO bands. There is a direct relation between the ratio of the same lines and that of the neighbouring parts of the continuous spectrum. In type Se, the ratio of the Balmer lines is normal except where TiO is strong. The abnormal Balmer line ratios in Ne and Re are related to the appearance of bands of C_2, CN, CH, etc. Anomalies of $H\epsilon$ are related to the broad absorption line *H*. The data suggest that the molecules concerned are at the same level in the stellar atmospheres as the H, if not higher. T. L. M.

2896. Interpretation of Line Emission in Long-Period Variables as Chemiluminescence. K. Wurm. *Zeits. f. Astrophysik,* 10. *pp.* 133–153, *May* 12, 1935.—The origin of bright lines in the spectra of long-period variables is ascribed to chemical reactions and especially to the recombination of atoms to form diatomic molecules in the upper atmospheres (chemiluminescence). From the marked variation of the molecular absorption in the course of the light alternation it is estimated that the total pressure in the layers in which recombination takes place is 10^{-2} mm. Hg. It is calculated that 5×10^{16} quantum processes must occur in a column of gas over a 1 cm.^{2} base in the photosphere in order that a bright line may appear, the photosphere temperature being taken as 2600° Abs., and this leads to a very plausible estimate of the stationary concentration of excited particles in the upper layers. It is to be expected that in stars with high molecular concentration in the outer layers a line and band emission should be superimposed on the photospheric alternating light. It is pointed out that the course of the dissociation and recombination processes of absorbing molecules influences the form of the visual and photographic light curves. J. E. K.

2897. Emission Line λ 4511 in Late-Type Variables. A. D. Thackeray. *Mt. Wilson. Observat., Contrib.* No. 517. *Astrophys. J.* 81. *pp.* 467–473, *June,* 1935.—The appearance in emission in M and S variables of the line λ 4511 (previously identified as the indium resonance line λ 4511·31) is suggested as due to the coincidence in wave-length of Hδ (λ 4101·75) with the other In resonance line (λ 4101·72). The behaviour of λ 4511 relative to Hδ during the cycle of variation is not at variance with the hypothesis, provided either that ionisation at light-maximum is sufficient to remove most of the In atoms out of the neutral state or that atoms in the metastable state $^2P_{\frac{3}{2}}$ are more likely to reach the ground state $^2P_{\frac{1}{2}}$ by collisions than to absorb λ 4511. AUTHOR.

2898. Theoretical Colour Temperatures. A. Pannekoek. *Roy. Astron. Soc., M.N.* 95. *pp.* 529–535, *April,* 1935.—The results derived by the author for the coefficients of continuous absorption for stars may be used to derive the intensity distribution over the continuous spectrum and thus the corresponding colour temperature. The tabulated results show that while the effective temperature decreases from 20,000° to 10,000°, the colour temperature for the part of the spectrum used at Greenwich remains near 20,000°, while for lower effective temperatures the colour temperature falls rapidly, descending below the other after 7000°. The cause is traced to the manner in which the mean absorption in a hydrogen atmosphere takes place. But the colour temperature is not a physical datum in the sense in which effective temperature is such. It varies with the wave-length used. Its correlation with colour index and effective wave-length is now seen to be due to the use of the same spectrum range. T. L. M.

2899. Gas Motions in Prominences, Wolf-Rayet Stars and Novæ. W. H. McCrea. *Roy. Astron. Soc., M.N.* 95. *pp.* 509–519, *April,* 1935.—In astrophysical manifestations of gas streaming, it is usual for different gases to move with nearly the same velocity, though most causes of motion would be expected to act differently on the elements concerned. The author examines the conditions for a dragging effect (density sufficient to prevent one gas from moving through the others at high relative speed). The force exerted by one gas on another moving through it is examined. The effective size of atoms for the processes considered is discussed. The astrophysical application is treated on the lines of Rosseland's theory of the chromosphere, from the point of view of velocity only. It is concluded that if the density of a prominence is analogous to that of the lower chromosphere, " drag " of one gas on another is adequate to account for observed velocities ; selective radiation pressure increases slightly the velocities of Ca + and H. Smaller densities would permit relatively rapid separation. In the expanding envelopes of Wolf-Rayet stars and Novæ, the densities required for dragging are quite plausible. A number of supplementary problems raised are specified. T. L. M.

2900. ζ-Aurigae : Structure of a Stellar Atmosphere. W. H. Christie and O. C. Wilson. *Mt. Wilson Observat., Contrib. No.* 519. *Astrophys. J.* 81. *pp.* 426–460, *June,* 1935.—This is an eclipsing binary, composed of a B and a giant K Star. During the eclipse of 1934, Aug.–Oct., 40 spectrograms were taken, and these yield valuable results. New elements for the system have been obtained ; the total absorption of the continuous spectrum of the B star has been measured as it shines through the various elements in the atmosphere of the K star ; the relative heights to which these elements extend, and the relative number of atoms existing at different levels above the photosphere of the K star, have been investigated ; and it has been ascertained that the hydrogen shell surrounding it is of uniform density. M. A. E.

2901. Dispersing and Condensing Tendencies in a Viscous, Compressible Gas. G. Strömberg. *Mt. Wilson Observat., Contrib. No.* 520. *Astrophys. J.* 81. *pp.* 474–478, *June,* 1935.—Certain conditions for general and local expansion and condensation in a viscous, compressible gas have been formulated. Applying them to the formation of the galaxy, we find that both expansion and contraction may occur. The stars are formed in the non-rotating, cool, and dense parts of the system. The original nebula has a much greater extension and mass than the system of stars that finally developed. AUTHOR.

2902. Relation of Open Star-Clusters to Galactic System. E. v. d. Pahlen. *Zeits. f. Astrophysik,* 10. *pp.* 100–132, *May* 12, 1935.—The problem dealt with is the relation, if any, between the distribution of open clusters within the galactic equatorial zone and that of galactic structure in general. A statistical method is given. The material is the galactic chart of Lundmark, with the catalogue of clusters by Trümpler. The author concludes that there is positive evidence of such a relation ; open clusters show a definite but not very strong preference for regions of higher star density and the borders of star-clouds. This appears inconsistent with the current view that the galaxy is in reality, behind absorbing matter, more uniform than appears to us. It also suggests that the galactic clouds occupy, to some extent at least, the same region of space as known open clusters. T. L. M.

2903. Spectrum Analysis of Hot Carbon Star, R Coronæ Borealis. L. Berman. *Astrophys. J.* 81. *pp.* 369–425, *June,* 1935.—A study of region $\lambda\lambda$ 4300–4900, where the spectrum resembles α Persei (cF$_5$), but without absorption or emission Balmer series or Fraunhofer's G (absorption) band. At maximum, it resembles the brightest Cepheids (cGop) and α Ursæ Minoris, and for its constant phase it is classified as cF7p. There is scarcely any hydrogen atmosphere, but abnormally abundant atomic and molecular carbon. At maximum there are strong enhanced metallic lines and rare earths, but metallic arc lines are weak, *Fe* having the greatest strength. Two neutral carbon multiplets (E.P. = 7·45) are very strong, but no strong neutral N or O lines exist in the observed region. An extensive atmosphere is suggested. Temperatures are: effective, 5300° K; colour, 6700° K ($\lambda\lambda$ 3500–4500), 7700° K ($\lambda\lambda$ 4500–6500); pressures: electron at base of reversing layer, $8\cdot3 \times 10^{-7}$ atm.; mean total, $9\cdot3 \times 10^{-6}$ atm. Ionisation level, 9·6 volts; surface gravity, $2\cdot7 \times 10^{2}$ cm./sec.^{2}. Number of atoms above 1 sq. cm.: neutral, $4\cdot4 \times 10^{21}$; ionised, $2\cdot3 \times 10^{20}$; total, $4\cdot9 \times 10^{21}$. A. S. D. M.

2904. Spectrographic Orbit of W Ursæ Minoris. A. H. Joy and O. L. Dustheimer. *Mt. Wilson Observat., Contrib. No.* 521. *Astrophys. J.* 81. *pp.* 479–481, *June,* 1935.—The orbit of the brighter component of the eclipsing variable W Ursæ Minoris has been determined from eleven spectrograms. The resulting elements are: $e = 0\cdot0$ (assumed), $\gamma = -7\cdot7$ km./sec., $k = 105\cdot5$ km./sec., $a \sin i = 2{,}470{,}000$ km., mass function $= 0\cdot21 \odot$. The spectral type is A4 and the spectroscopic absolute magnitude is $+2\cdot2$. The mass, density, and absolute dimensions of the components have been estimated with the assistance of Dugan's photometric orbit and Eddington's mass-luminosity curve.

AUTHOR.

2905. Visual Observations of Nova Herculis. M. G. Fracastoro. *Accad. Lincei, Atti,* 21. *pp.* 269–271, *Feb.* 17, 1935.—The light-curve of this star, as observed at Arcetri from Dec. 30, 1934, to Feb. 19, 1935, shows a slower rise to maximum, a quicker descent, and a more marked sequence of lesser maxima, than is usual with Novæ. M. A. E.

2906. Spectrum of Nova Herculis. G. Righini. *Accad. Lincei, Atti,* 21. *pp.* 272–277, *Feb.* 17, 1935.—From Jan. 4, 1935, spectrograms were taken at Arcetri with the prismatic reflector, which has a dispersion of 30 Å/mm. at λ 4000. A microphotogram of a plate taken on Jan. 14 shows the relative intensities of the bright lines, and a table gives the measurements of position, the elements, and the intensities. A colour-temperature of 10,500° K. was determined by comparison of the continuous spectrum with that of α Coronæ. M. A. E.

2907. Nova Herculis, 1934. Light Curve. P. M. Ryves. *Roy. Astron. Soc., M.N.* 95. *pp.* 535–537, *April,* 1935.—The author gives a curve based entirely on his observations down to 5th March and discusses some peculiarities of the curve, and resemblances to the behaviour of V Sagittæ. T. L. M.

2908. Nova Herculis, 1934. Light Curve and Visual Spectrum. A. Beer. *Roy. Astron. Soc., M.N.* 95. *pp.* 538–548, *April,* 1935.—The light curve is based on 4562 observations from various sources, reduced to Harvard system, but not otherwise corrected. The principal variations are discussed. 400 spectrum plates have been secured at the Solar Physics Observatory, 112 with the 15-in. refractor, covering Hβ to Hα. A table of emission lines measured on a selection of the latter, with identifications and notes, occupies the greater part of the paper. T. L. M.

2909. Colour Temperature of Nova Herculis. R. M. Petrie. *Astrophys, J.* 81. *pp.* 482–484, *June,* 1935.—Colour temperatures are derived from the spectrophotometric gradients of ten spectra. The mean value, uncorrected for atmospheric extinction, is $T = 10{,}500°$ K. AUTHOR.

2910. Calcium H and K Emission and Absorption Lines in Nova Herculis, 1934. B. Lindblad and Y. Öhman. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*B. No.* 4. *pp.* 1–5, 1935. *In English.*—A special development in the H and K absorption and emission is the appearance of faint emission and absorption lines (H_2 and K_2) at the centre of the heavy absorption, H and K. The conditions are illustrated by a diagram and table of the micrometer tracings of the region on December 27th, January 9th and 19th, and indicate the increase of strength with time of the absorption lines of H, Ca II and Ti II ; the apparent shift of H_2 and K_2 to the red on January 19th is due to an unsymmetrical widening of the absorption lines which is greater in the higher levels, thus cutting off the short wave-lengths of the broad emission A. H and K heavy absorption is produced in gaseous layers of rapid outward motion ; the spectral shifts of Ca are given for the three dates and correspond to − 300, − 460 and − 515 km./sec. Emission H_2 and K_2 (emission B) corresponds to a very high level and thus gets *apparently* displaced to the red, but its absolute wave-length is nearly constant. This emission B seems to support the reality of the outward-moving gaseous shell. Emission A must be largely produced by the resistance through encounters of the swiftest atoms with the slower ones ; it must be broad and on the average considerably less displaced towards the violet than the absorption lines. A. S. D. M.

2911. Interpretation of Nova Emission Bands. B. P. Gerasimovič. *Zeits. f. Astrophysik,* 10. *pp.* 154–159, *May* 12, 1935. *In English.*—Recent progress in interpreting the contours of emission bands in Novæ is shortly reviewed. The author's method of deriving the law of velocities in Novæ envelopes is applied to Nova Ophiuchi 3 and Nova Herculis. It appears that, if the interpretation of Nova emission bands in terms of expanding envelopes of non-uniform velocity is correct, the velocities decrease with the increasing distance from the parent star. AUTHOR.

2912. Photometry of Stellar Twinkling. M. Minnaert and J. Houtgast. *Zeits. f. Astrophysik,* 10. *pp.* 86–99, *May* 12, 1935.—A photographic plate is driven at uniform speed across the focal plane of the telescope. Each star gives a trail, which is not uniform on account of twinkling. The authors have studied the variations of the trail with the microphotometer, and converted them into variations of intensity. The material can be used to determine the frequency and amount of twinkling, its relation to zenith distance, and the effect of aperture. The grain of the plate, however, introduces additional variations, which can only be separated statistically from the effects of twinkling. New methods are given for determining the speed, amount, and altitude of the atmospheric disturbances responsible. T. L. M.

See also Abstracts 2882, 2886, 2887, 2988, 2999, 3000, 3001, 3010, 3031, 3073.

SUN.

2913. Height of the Chromosphere in 1934 and Course of the Solar Cycle. G. Abetti. *Accad. Lincei, Atti,* 21. *pp.* 294–296, *March* 3, 1935.—Observations made at Arcetri on 114 days of the year 1934 show a slight general diminution in height of the chromosphere compared with that in 1933. The mean is 10″·44, with maxima at the poles. At the Stefanik Observatory in Prague similar observations were made: the mean value is lower, but the distribution in latitude agrees well. The total area of prominences, measured in Arcetri, Catania, and Zurich, is 124 units greater than in 1933. The first spot group of the new cycle appeared on October 10th, 1933, and minimum may now be determined as having occurred towards the end of 1933, so that the past cycle was only 10·3 yr. instead of the average 11·1 yr. The two maxima of high-latitude prominences moved from 40° N and 37° S in 1933 to 45° in both latitudes in 1934. Dark and bright markings on the disc showed very little activity.
M. A. E.

2914. Coronal Number and Periodic Change of Shape of Solar Corona. Ö. Bergstrand. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*A. No.* 4. *pp.* 1–14, 1935. *In German.*—The shape of the corona is determined by the lines of equal brightness, and in particular by the ratio of polar to equatorial diameter. The change of this ratio with distance from the sun does not obey a simple law throughout (Ludendorff). The author regards the polar illumination as due to a true polar corona with superimposed illumination by the long equatorial rays. He therefore introduces a coronal number p, the ratio of the true polar corona to the equatorial corona at the same altitude above the sun's surface. Values of p are derived from eclipses, 1893–1932. It remains about 0·3 in the first half of the solar cycle, rises at increasing rate to 0·8 at the end of the cycle, and falls rapidly, perhaps discontinuously, to its initial value. Relations to other solar quantities and certain of Ludendorff's conclusions are discussed.
T. L. M.

2915. Intensity of Solar Radiation at the Surface of the Earth. H. H. Kimball. *Monthly Weather Rev.* 63. *pp.* 1–4, *Jan.,* 1935.—Having stated the principal causes of variation both as regards intensity and quality, the author proceeds to discuss in the first place the radiation intensities received in different latitudes and at various altitudes during particular months of the year. With the aid of the solar constant and the atmospheric transmission coefficients for different stations obtainable from a graph, the corresponding solar radiation intensities may be calculated for any mass of air passed through. Daily totals of radiation are next dealt with and graphs are drawn showing these daily totals received at different stations and under different conditions of cloudiness throughout the year. Smoky cities show less radiation received than those with a clear atmosphere. Comparison is also made between amounts received in the Arctic regions and at stations in lower latitudes. The author then deals with the variations in the quality of solar radiation. Measurements from three stations, Zugspitze, Blue Hill, Mass., and Washington, are summarised, the spectrum being divided into three portions, red, blue and visible. The relations found from the summary are: (1) a percentage increase of blue with decrease of air mass; (2) a percentage decrease of red with decrease of air mass; (3) variations in the visible part small but in agreement with previous work. A series of normal solar radiation curves is plotted. A. E. M. G.

2916. Computing Tables of Heliographic Coordinates and Earth Component of Rotational Velocity of Observed Point on Sun. R. E. de Lury. *Dominion Obs. Ottawa, Publ.* 6. *Pt.* 1. *pp.* 71–84, 1934.—Carrington's values for inclination ($I = 7° 15'$) to the ecliptic, and longitude ($N = 73° 40'$ for $1850 \cdot 0$) of the ascending node for the sun's equator, are used. Tables are given for Sin Bo Cos ρ; for Cos Bo Sin ρ in terms of r (distance of observed point from centre of solar disc) where Bo is heliographic latitude of sun's centre, and ρ is the heliocentric angle; and for Cos α, sec ϕ (α = position angle of observed point and ϕ = its heliograph latitude). A description is given (with plate and tables) of a graduated sphere and coordinate frame from which the required quantities can be read off. A. S. D. M.

2917. Solar Rotation and Red-Shift from H and K Lines in Prominences. J. Evershed. *Roy. Astron. Soc., M.N.* 95. *pp.* 503–509, *April,* 1935.—This paper combines the results already published [see Abstract 1806 (1929)] with 400 additional spectra covering 1929–34. The angular speed of prominences is apparently greatest at times of maximum solar activity, but does not vary with the latitude. But the angular speed for prominences with small random motions exceeds that of sunspots by at least 1° per day. Successive meridian passages of prominences do not show this difference. The author suggests that the point of origin of the prominence rotates with the speed of the photosphere while the spectrum material relates to the gases driven forward in the direction of rotation and dissipated on emerging from the chromosphere. Deeper origins at times of great activity then account for excess speeds at such times. The red shift of H and K is found to exceed the relativity shift ($0 \cdot 0081$) by not less than $0 \cdot 005$ and not more than $0 \cdot 0065$ Å. T. L. M.

See also Abstracts 2899, 3073.

GEOPHYSICS.

HYDROSPHERE, PHYSICS OF THE.

2918. Problems of Tidal Forces. O. Pettersson. *Arkiv f. Mat. Astron. och Fysik, Stockholm, 25A. No.* 1. *pp.* 1–11, 1935.—The vertical tidal force is defined and formulæ given for its calculation. The construction of curves of the internal parallactic tide is described. The nature of the monthly curves is discussed. The presence of such an internal tide of long period and small dimensions is verified indirectly by measures of the composition of water at different depths and by barometer observations during polar night. [See also Abstract 3611 (1934).] T. L. M.

2919. Principal Semidiurnal Constituent of Tidal Motion in Bay of Biscay. S. F. Grace. *Roy. Astron. Soc., M.N. Geophys. Supplement,* 3. *pp.* 274–285, *May,* 1935.—The M_2 tidal motion is determined as for the Gulf of Mexico, the area being divided into ten rectangular basins and observations at nine coastal stations, and of currents being used. The average difference between calculated and observed results is 9 % in amplitude and 7° in phase, and the co-tidal and co-range charts agree with those for the English channel. The tidal wave from the Atlantic splits off Brittany, the right portion circulating clockwise in the Bay with a semirange increasing from 120 cm. in the west to 150 cm. at the coast, and an average maximum flood current of 11 cm./sec.; the left portion passes up the Channel, the semi-range rising rapidly to 200 cm. and the maximum flood current to 26 cm./sec. C. A. S.

2920. Seiches in a Channel. K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 5. *pp.* 327–358, *March,* 1935. *In English.*—Reference is made to the theory developed for land-locked basins and those in a gulf or bay in earlier publications. In the paper the possibility of seiches being generated in a channel communicating on both sides with the open sea is demonstrated on theoretical grounds, the coasts of the channel being represented by two branches of a hyperbola, and with and without allowance being made for the earth's rotation. In such a channel an infinite sequence of free oscillations with finite lengths of periods can occur, the distribution of amplitude over the channel being given in terms of Mathieu and associated Mathieu functions. Numerical examples with three different shapes of channel are given and diagrams illustrate the results. Using a self-recording tide gauge of the Honda type on the Akasi Straits the records illustrate the oscillation which is presumed to be due to seiches. R. S. R.

2921. Effect of a Steady Wind on the Surface Level of a Canal. K. Koenuma. *Imp. Marine Obs., Kobe, Japan, Mem.* 5. *pp.* 359–372, *March,* 1935. *In English.*—The effect of a steady wind on the surface level of an infinitely long canal whose coasts are parallel to one another is examined theoretically, the inclination of the surface and the tangetial stress due to the wind being considered as a function of the distance from the coast. The theory is also extended to the case of a sea with a straight coast, one of the coasts of the canal being considered to be at infinity. For a shallow canal the surface elevation is produced by the stress component perpendicular to the coast and the effect of the stress parallel to it may be neglected, but the reverse holds for a very deep canal. R. S. R.

LAND, PHYSICS OF THE.

2922. Visco-Elastic Properties of Pitch-Like Materials. K. Iida. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. *pp.* 198–212, *March,* 1935. *In English.*—The modulus of rigidity and the viscosity coefficient of the substance decrease with increasing temperature, the former vanishing at the melting point. The viscosity of paraffin decreases discontinuously at its melting point, but this was not observed in the case of pitch. The dual properties of viscosity and elasticity shown by these substances may be explained by assuming that their structure is analogous to a sponge, *i.e.*, the cavities of an elastic skeleton filled by a viscous liquid. If the material of the earth's interior has similar mechanical properties, no sensible accumulation of stress will take place in it, and the folding of mountains and kindred phenomena may be explained without difficulty. W. A. R.

See also Abstract 2886.

METEOROLOGY.

2923. Adsorption of Radon on Nuclei. G. Aliverti and G. Rosa. *Gerlands Beitr. z. Geophys.* 44. 2. *pp.* 107–111, 1935. *Accad. Sci. Torino, Atti,* 70. 2. *pp.* 266–271, 1934–1935.—From a consideration of the portions of the total effect, as recorded by Aliverti's method, attributable to (i) Ra A + B + C, (ii) radon, and (iii) Th-emanation, it is shown that even a partial adsorption of radon on nuclei is very doubtful. [See Abstract 4937 (1934).] C. A. S.

2924. Measurements of Atmospheric Radiation with Restricted Apertures. S. L. Malurkar. *Gerlands Beitr. z. Geophys.* 44. 2. *pp.* 127–128, 1935.—The amount of radiation falling on an element of surface is deduced from that falling thereon through a limited aperture, *i.e.* so that the region whence the radiation can come is bounded by a right cone, with axis vertical and of given vertical angle. [See Abstract 531 (1933).] C. A. S.

2925. Registering-Balloon Ascents in a Deep Depression. E. Palmén. *Soc. Scien. Fennica, Acta & Comm. Phys. Math.* 8. 3. [32 *pp.*]. 1935.—A series of 6 meteorograph ascents were made at Ås and 5 at Uccle on February 2nd–3rd, 1933, to determine the structure of a deep depression as it crossed Scandinavia. The pressure distribution is discussed and illustrated and the temperature soundings are set out in tables and diagrams. A full discussion is given of the temperature, pressure and wind distribution in the free atmosphere and of tropospheric and stratospheric processes. R. S. R.

2926. Correlation between Pressure, Temperature and Tropopause Height. H. Hoffstedt. *Soc. Scien. Fennica, Acta and Comm. Phys. Math.* 8. 4. [14 *pp.*], 1935.—The observations from 69 registering balloon ascents made in England, Oct.–March, 1924–30, were used. These were divided into cases of polar (55) and tropical (14) air respectively and all cases where the balloon penetrated a surface of discontinuity, or did not reach the tropopause, were excluded. Correlation coefficients between pressure, temperature, potential temperature and tropopause height were found and tabulated for the two types of air mass. The results for polar air were compared with those obtained by other authors. It is shown that besides the local adiabatic effect other causes such as vertical oscillation and advective processes are of importance at least for the troposphere and lower stratosphere. R. S. R.

2927. Lunar Atmospheric Tide Over Canada. S. Chapman. *Roy. Meteorolog. Soc., J.* 61 *pp.* 359-365; *Disc.,* 365-366, *July,* 1935.—The material is taken from five stations, three in the east (St. John, Montreal, Toronto) and two in the west (Vancouver and Victoria), and averages 23 years per station. The second harmonic component of the lunar atmospheric tide is determined. The three eastern stations give similar values for this component, the mean values being 28 sin $(2t + 77°)$ microbars. This is the normal for the mean latitude of the stations. A much smaller tide occurs at the western stations, the mean being 4 sin $(2t + 101°)$ microbars. This is extremely low for the mean latitude of these two stations. In the east the amplitude and phase angle are both less in Dec. than in June, in this resembling most other stations. In the west the seasonal variation cannot be adequately determined. The harmonic coefficients of the first four components of the solar diurnal variation are also given and the amplitude of the second component is here also less in the west than in the east. A. E. M. G.

2928. Effect of Wind, Temperature, Humidity and Sunshine on the Loss of Heat of a Body at Temperature 98° F. E. Gold. *Roy. Meteorolog. Soc., J.* 61 *pp.* 316-331; *Disc.,* 331-343, *July,* 1935.—The terms "cool," "warm," etc. as applied to weather depend on other factors than temperature. The cooling or warming of a body depends on radiation, convection, evaporation. Diagrams are gven showing isopleths of the cooling power of air for various wind velocities and temperatures for a body at 98° F. under different conditions. The cooling power of the air at an exposed position is computed and it is found that this shows little difference by day and by night. When the wind value is reduced to that ordinarily experienced in unexposed situations the mean values of cooling power are reduced by about one third. The author next computes the effect on cooling power of solar and sky radiation in the day time and also the effect of loss of heat by radiation to sky and earth at night. The latter is small compared with losses due to convection and radiation to surroundings at the temperature of the air. Next the relation between cooling power and the terms hot, cold, etc. is examined and a scale suggested. From this a scheme of terms appropriate in different conditions of temperature, wind and cloud is obtained, while a specification of terms in relation to wind temperature and wet bulb temperature is also given. A. E. M. G.

2929. Bracing and Relaxing Climates. W. F. Tyler. *Roy. Meteorolog. Soc., J.* 61 *pp.* 309-315; *Disc.,* 331-343, *July,* 1935.—Reactions to climatic stimuli may be physiological, physical or neurological. The last named effects are connoted by the terms "bracing" and "relaxing." The author having classified a number of stations as bracing, relaxing or intermediate, considers the question of stimulus. Humidity is found to be higher by about 2 % at bracing stations than at relaxing, but this does not imply that bracingness marches with humidity. He considers that the factors concerned are of two kinds, (1) a set pertaining to a particular locality and so giving rise to the general existence of bracing or relaxing conditions, and (2) a set which functions erratically. At the present time there is difficulty in deciding on the cause of these factors. The author suggests that probable causes are the wind or the nature of the soil. A. E. M. G.

2930. Choice of Visibility Marks. W. E. K. Middleton. *Monthly Weather Rev.* 63. *pp.* 17–19, *Jan.*, 1935.—The present method of estimation of visual range being unsatisfactory, the author suggests the following as criteria of a more satisfactory method : (1) observations made at different stations shall be intercomparable, (2) observations made by night shall be comparable with those made by day. The visual range by day of a black object or gray object of albedo R against the horizon can be given in terms of σ the extinction coefficient of the atmosphere, and also that by night in terms of the same coefficient and of the candle power of the light used and E the threshold flux density. From equations connecting these quantities tables are calculated showing relation between σ and S the visual range both for day and night. From a consideration of these relationships it is concluded (1) that for observations in the daytime it is advisable to confine choice of marks to black objects against the horizon sky, and (2) that the general adoption of some sort of transmission meter is desirable to make night measurements independent of local conditions. A. E. M. G.

***2931. Electrical Registration of Sky Polarisation. Z. Sekera.** *Gerlands Beitr. z. Geophys.* 44. 2. *pp.* 157–175, 1935.—In the method described the light from the selected part of the sky passes through a nicol prism, rotating uniformly round its optic axis, and falls on a photo-cell. The resulting alternating photoelectric current is registered by means of a galvanometer or electrometer and a photographic method. From the maxima and minima of the registrations the intensities of the components of the polarisation are calculated. The apparatus is described and illustrated and it was used in the summer of 1932 at Prague and Ondřejov. The results obtained are compared with those obtained simultaneously with a Marten's photopolarimeter. Good agreement is obtained in the absence of polychroism, but when this was present the values obtained by the self-recording method were smaller probably because of different sensitivity of the eye and the rectifier cell. The accuracy ranged from 0·3 % at 20° to 3·2 % at 2° elevation. Improvements to be made in the apparatus are discussed. [See Abstract 4013 (1933)]. R. S. R.

***2932. Hygrometric Calculator. L. G. Gray.** *Monthly Weather Rev.* 63. *pp.* 16–17, *Jan.*, 1935.—This device which is intended to expedite the calculation of certain hygrometric factors consists of an ordinary drawing board and T-square, with suitable scales. Lines drawn from a common centre on the board represent relative humidity. On the edge of the T-square equal intervals represent a scale of vapour pressures. The T-square scale is placed across the lines on the board, with the head pressed against the edge of the board. The device is illustrated by a line diagram and its use in the calculation of numerical examples is demonstrated. A. E. M. G.

***2933. Pressure in an Aneroid Barometer and its Compensation for Temperature. T. Sano.** *Imp. Marine Obs., Kobe, Japan, Mem.* 5. *pp.* 373–426, *March*, 1935. *In English.*—A practical method of determining the optimum pressure of the residual gas in an aneroid barometer in order to obtain compensation for temperature, and the results arrived at are discussed. A theoretical solution of the problem is also described and some numerical examples are given. The calculated results are found to agree fairly well with those of experiment. The author shows, however, that more accurate determination of the internal pressure and more precise measurement of the various constants involved in the equations

are necessary to verify the theory. In a series of appendices the variations of the quantities involved are discussed, and in particular the relation between the temperature at which compensation is perfect and external and internal pressure. Tables are given showing these variations.
A. E. M. G.

***2934. New Method of Sounding by Radio. V. Väisälä.** *Soc. Scien. Fennica, Acta & Comm. Phys. Math.* 8. 14. [12 *pp.*], 1935.—By alteration of the capacities of condensers due to changes in temperature and pressure, the wave-lengths of radio waves can be made to give records which directly show the change of pressure or temperature at any point. The method can also be applied to humidity, but for other phenomena the cost is yet too great. The apparatus to give continuous records of baro-, thermo-, and hygro-metric conditions weighs 430 gm. and costs 20 dollars.
H. M. B.

***2935. Wet- and Dry-Bulb Hygrometer at Low Temperatures. J. H. Awbery and E. Griffiths.** *Phys. Soc., Proc.* 47. *pp.* 684-702, *July,* 1935.—True humidity corresponding to various wet- and dry-bulb temperatures between − 2° C. and − 19° C. has been measured. The wet-bulb temperatures were obtained by means of mercury theromometers, thermocouples and resistance thermometers, all three methods agreeing well. The true humidity was generally obtained from a specially designed dew-point apparatus, thermojunctions being used to measure the temperature of the metal surface on which the deposit of dew was formed. In addition, tests by the gravimetric method were carried out. The results are utilised to prepare a table giving the relative humidity at various wet- and dry-bulb temperatures. These agree, for the most part, with previous tables, but they differ in the region of low dry-bulb temperatures (below about − 9° C.) and small wet-bulb depressions (less than 1° C.). The results are examined from the point of view of the usual formula. Above 0° C. the formula is found to hold well, but below 0° C. the psychrometric constant varies in a complicated manner with the temperatures. It tends to infinity when the wet-bulb depression tends to zero, and there is a further variation superimposed on this one; at a constant value of the depression it passes through a minimum and then through a maximum as the dry-bulb temperature decreases. AUTHORS.

See also Abstracts 2951, 3101, 3126.

SEISMOLOGY.

2936. M_2 Seismic Waves. K. Sezawa and K. Kanai. *Imp. Acad. Tokyo, Proc.* 11. *pp.* 96–98, *March,* 1935.—The two dispersion curves of Rayleigh waves, previously found [see Abstract 1072 (1935)], may exist even in the case in which the difference in the elastic constants and the densities of the two media is not very marked. These M_2 and M_2' phases were found in the Tokyo record of the great India earthquake of Jan. 15, 1934.
W. A. R.

2937. Love Waves Generated from a Source of a Certain Depth. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. *pp.* 1–17, *March,* 1935. *In English*—The displacement of the Love waves varies as a negative exponential function of the depth when the origin is in the lower medium, but as some harmonic function of the depth when the origin is in the surface layer. The distribution of the displacements of the accompanying distortional wave is somewhat similar.
W. A. R.

2938. Periods and Amplitudes of Oscillations in L- and M-Phases. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. *pp.* 18–37, *March*, 1935. *In English.*—The distribution of the displacements due to Love waves in the media, through which they are transmitted, is calculated for comparison with similar data concerning Rayleigh waves, previously published [Abstract 1072 (1935)]. W. A. R.

2939. Earthquake Waves in the Neighbourhood of the Earth's Core. T. Matuzawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. *pp.* 39–45, *March*, 1935. *In German.*—The properties of waves through the core and in the so-called " shadow-region " are investigated with reference to the nature of the core boundary. W. A. R.

2940. Theory of Microseisms. S. K. Banerji. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 727–753, *April*, 1935.—In continuation of previous work [see Abstract 3954 (1930)] experiments were made in tanks in imitation of the conditions in the sea and these show that the disturbance is transmitted by the effect of compressiblity of water. A theoretical analysis of the effect of compressibility confirms the experimental results. The casues of microseisms are discussed. The gusts of wind have the same periods as the microseisms ; the pressure fluctuations due to these behave as a slow acting force on the seismograph pillar if these have direct access to the instrument. The best situation for a seismograph seems to be an underground room with a channel of " dead " air all round, which damps pressure fluctuations. When an instrument is adjusted so as to record no microseisms when the neighbouring seas are calm, but records them as soon as they are disturbed, the intensity of microseisms is found to be proportional to the intensity of the disturbances on the surface of the sea. Author.

2941. Periods of Vibration of Buildings an Index to Their End Conditions. J. J. Creskoff. *Frank. Inst., J.* 219. *pp.* 573–581, *May*, 1935.—The importance of determining the end conditions of buildings considered as cantilevers in the dynamical design of aseismic structures is stressed. Various conditions of free, hinged and sliding ends are considered, and the formulæ derived seem capable of predicting the vibration periods of some actual structures. W. A. R.

2942. Rayleigh Waves over the Circular Cylindrical Surface of an Elastic Body. Y. Nomura. *Phys. Math Soc. Japan, Proc.* 17. *pp.* 151–162, *May*, 1935. *In English.*—Rayleigh waves over the circular cylindrical surface of an isotropic homogeneous elastic body propagating along its axis, and especially the effect of the curvature upon them are investigated. Author.

2943. Surface Waves of Earthquakes. H. Jeffreys. *Roy. Astron. Soc., M.N. Geophys. Supplement*, 3. *pp.* 253–261, *May*, 1935.—The principle of stationary period is applied to Love waves where the lower layer is assumed heterogeneous [see Abstract 742 (1929)], showing that it gives satisfactory results when the complexity of the system is too great for a formal solution. It is then applied to Rayleigh waves, showing that, though not so generally applicable, under certain conditions it gives useful results in reasonable agreement with observation. C. A. S.

2944. Apparent Velocities of Earthquake Waves over Surface of Earth. R. Stoneley. *Roy. Astron. Soc., M.N. Geophys. Supplement*, 3. *pp.* 262–271, *May*, 1935.—From data recorded at Göttingen for three earthquakes that occurred in East Asia the wave velocity has been deduced from the group velocity. The results for Love waves are consistent with an upper layer of granite, thickness about 15 km. and a lower one twice as thick of dunite [see Abstract 4114 (1931)], while for periods < 30 sec. the sedimentary layer is important. Similar calculations from data for an earthquake in Mexico recorded at Apia point to an upper layer of granitic material beneath the Pacific about 10 km. thick, resting on ultrabasic rock. The refraction effect due to change in velocity when the waves pass from continental to oceanic areas is shown to be small, the error resulting from its neglect being $\ngtr 1\,\%$. C. A. S.

2945. Ellipticity Correction in Seismology. H. Jeffreys. *Roy. Astron. Soc., M.N. Geophys. Supplement,* 3. *pp.* 271–274, *May,* 1935.—The suitability of Gutenberg and Richter's method of correcting for ellipticity (see Abstract 565 (1934)] is investigated mathematically. C. A. S.

2946. Experiments on Artificial Earthquakes. W. Inouye and H. Kimura. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. *pp.* 194–197, *March,* 1935. *In English.*—Experiments of disturbances produced by allowing a heavy weight to fall in a pit show that initial motions near the origin were " pulls," and at a distance from the origin were " pushes." W. A. R.

2947. Three Components of Microseismic Disturbance at Kew Observatory. Discussion of the Records for 1932. A. W. Lee. *Meteorolog. Office, Geophys. Mem.* 7. *No.* 66. [10 *pp.*], 1935.—The microseisms recorded during 1932, by the N–S, E–W and Z components of the Galitzin seismograph at Kew Observatory have been tabulated for four hours daily. The mean amplitudes and periods of the three components for the whole year are approximately equal ($0{\cdot}9\mu$ and $5{\cdot}6$ sec.). The amplitudes of the two horizontal components are nearly equal for all periods, but the ratio of horizontal to vertical amplitudes diminishes from about $1{\cdot}2$ for microseisms of period $4\frac{1}{2}$ sec. to $0{\cdot}85$ for periods of 9 sec.; this variation is consistent with the hypothesis that the microseisms may be regarded as Rayleigh waves through granite covered by a superficial layer. The yearly mean amplitudes of the simple Rayleigh waves with energy equal to that of the microseisms are $0{\cdot}5\mu$ in the horizontal and $0{\cdot}8\mu$ in the vertical components. AUTHOR.

2948. Polarisation of Seismic Waves in the Primary Phase of Earthquakes. A. Dinca-Samuracas. *Comptes Rendus,* 200. *pp.* 1772–1773, *May* 20, 1935.—Seismograms obtained at Strasburg of Roumanian earthquakes showed a much larger amplitude for the E–W and V components of the P and S waves than for the N–S component. It occurs only for earthquakes received along this track. The author attributes the effect to (1) the natural period of subterranean strata reinforcing certain categories of waves and not others, (2) the importance of density of the surface layers, and (3) the modifications produced by strata between the epicentre and place of observation. R. S. R.

***2949. Seismometers. G. A. Irland.** *Bureau of Mines, Techn. Paper* 556. [48 *pp.*], 1934.—A simple lightweight portable instrument to record vibrations due to blasting, etc., was required and the results of an investigation of the advantages of seismometers which record displacements and instruments which measure velocity or acceleration are set out, and the theory of the instruments and actual records correlated. In an appendix a mathematical analysis of the motion of the centre of oscillation of the seismometer arm is given and examples of computations by which the performance of an instrument may be determined theoretically. It is shown that seismometers should be so designed that the initial value of transient effects is negligible. Direct spring support for the arm of a vertical component seismometer is shown to be unsatisfactory. The theory of geometrical compensation is developed and computations are made showing application of the theory to actual design. R. S. R.

2950. Instrumental Earthquake Magnitude Scale. C. F. Richter. *Seismological Soc. of America, Bull.* 25. *pp.* 1–32, *Jan.*, 1935.—The author proposes to define the magnitude of a shock as the logarithm of the calculated maximum trace amplitude, expressed in microns, with which the standard short period torsion seismometer would register that shock at an epicentral distance of 100 km. The method is convenient and its use is illustrated by many applications, but no great accuracy is claimed for it. W. A. R.

See also Abstract 2954.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2951. Electricity of Rain and Thunderstorms. R. Gunn. *Terr. Mag.* 40. *pp.* 79–106, *March*, 1935.—Following an introduction dealing with the factors which influence the distribution of free charge the author discusses first the electricity of rain. There it is shown that if each water droplet and the moisture laden atmospheric ions surrounding it be assumed to constitute an electric concentration cell then the observed properties of raindrops having different life histories can easily be described. The charges so calculated are found to be in agreement with observation. The next section dealing with a theory of thunderstorm electricity, shows that with a rapidly rising air current and with the formation of rain drops above a critical size separation of charge takes place. The charge distribution arising from the separation is calculated and agreement obtained with observation as regards potential difference, electrical field, etc. The author proceeds to show that special thunderstorm conditions in mountainous regions would maintain the earth's charge by bringing down sufficient negative charge on rain and transferring positive charge upwards. It is further considered that forced vertical convection over mountain barriers in fair weather may also contribute towards this end. A. E. M. G.

***2952. Sampling Errors of the Aitken Nucleus Counter. F. J. Scrase.** *Roy. Meterolog. Soc., J.* 61 *pp.* 367-378; *Disc.*, 378-379. *July*, 1935.—After indicating the method of taking a nucleus count with the Aitken counter, the author shows that the observed frequency distribution of such nucleus counts agrees with that deduced theoretically by aid of Poisson's exponential limit to the binomial expansion. Also it is found that the standard deviation σ bears a simple relation to the mean number of nuclei in a count m, viz. $\sigma = m^{\frac{1}{2}}$, so that the distribution obeys the law of small numbers. As the total number of nuclei counted at a set of observations is 100, this gives a standard error of about 9 per cent of the mean. To reduce the error the total number counted must be increased. Further, the results

of the investigation enable a distinction to be made between genuine fluctuations and random errors, and also indicate that a random distribution of nuclei is produced in the apparatus without the aid of a stirrer.
A. E. M. G.

2953. Auroral Investigations at Franz Josef Land. J. Scholz. *Gerlands Beitr. z. Geophys.* 44. 2. *pp.* 145–156, 1935.—A long series of measurements at two-minute intervals was obtained on two nights, when there was a cloudless sky and a calm, of the potential gradient, air-earth current and appearance of the aurora and the individual values are tabulated. The potential gradient and current decrease 25 to 50 % a short time before and during the occurrence of visible auroræ, while with coloured auroræ the current may even be reversed. These changes were much greater than incidental seasonal changes. They are ascribed to the negative corpuscular stream which forms the aurora. As, however, the Heaviside layer serves as the outer conductor for the earth as a condenser this would produce a decreased potential gradient. The author therefore considers the auroral stream contains positrons and electrons and the earlier arrival of the former causes the increased potential gradient. The different potential of the Heaviside layer on the sides near to, and away from, the corpuscular stream also plays a part. R. S. R.

2954. Electro-Telluric Phenomena. E. K. Müller. *Gerlands Beitr. z. Geophys.* 44. 1. *pp.* 56–58, 1935.—Reference is made to a number of phenomena of an electrical character observed in electric cables in mountainous regions which appear to be due to changes in the electric potential in the earth's crust. They may precede, accompany or follow earthquake phenomena. It is considered that they may be produced by mechanical processes, displacements of material, or pressure changes in heterogeneous material or by humidity changes which produce gaseous or thermal action and so produce electrical forces which disturb the normal earth current. All earthquakes registered, however, may not show these effects. R. S. R.

RADIOACTIVITY.

2955. Energy of Disintegration and Possible Structure of Radioactive Nuclei. G. J. Sizoo. *Physica*, 2. *pp*. 472–482, *May*, 1935. *In English*.—If the values of the energies of the α-disintegration are plotted against $M - 1 \cdot 5 Z$, two curves are obtained: one for the atoms with even charge number and one for those with odd charge number. The points for the "odd atoms" can be brought on the curve for the "even atoms" by subtracting $2m_0c^2$ from the energy of disintegration and adding 6 to the value of $M - 1 \cdot 5 Z$. If the values of the upper limit of the continuous β-spectrum are plotted against $M - 1 \cdot 5 Z$, two groups of points are obtained: one for the odd atoms and one for the even ones. For the first group the upper limits are higher than for the second. The supposition is made that the even elements contain $\frac{1}{2}Z$ α-particles and $M - 2 Z$ neutrons, and the odd elements $\frac{1}{2}(Z - 1)$ α-particles, $M - 2Z + 1$ neutrons and 1 proton. AUTHOR.

2956. Formulæ for Ionisation by α-Particles. M. Francis. *J. de Physique et le Radium*, 6. *pp*. 215–220, *May*, 1935.—An examination of the analytical expressions due to Bragg, Geiger, Flamm and the author [see Abstract 2043 (1935)] for the ionisation produced by the α-rays emitted by a layer of radioactive material. The author's composite equations and Bragg's original equations are found to be more satisfactory than those proposed by Geiger and others. W. E. P.

2957. Collisions of α-Particles in Deuterium. E. Pollard and H. Margenau. *Phys. Rev.* 47. *pp*. 833–841, *June* 1, 1935.—Using three different but complementary experimental arrangements for examining deutons emitted from deuterium under bombardment by α-particles from a polonium source of 20 millicuries, determination is made of (1) the yield of deutons projected forwards as a function of the velocity for α-particles of homogeneous velocity, (2) the absorption of deutons projected forwards by α-particles of range up to 3·9 cm. at S.T.P., (3) the yield of deutons as a function of the angle of projection for α-particles of ranges 3·7 cm. and 1·9 cm. respectively. Comparison experiments were made with ordinary hydrogen. The results show (1) anomalous scattering begins at relatively greater α-particle energies for deuterium than it does for hydrogen; the nuclear field becomes non-Coulombian when the α-particle is about $3 \cdot 2 \times 10^{-13}$ cm. from the centre of the deuton compared with $4 \cdot 6 \times 10^{13}$ cm. for hydrogen, (2) irregularity in the deuton yield for incident α-particles of about 1·4 cm. energy, interpreted as a resonance phenomenon, (3) angular variation in the scattering which cannot be explained on Taylor's theory. For hydrogen neither the positions of some of the minima nor the existence of others agree with those found by Pose and Diebner. F. C. C.

2958. Tracks of α-Particles and Protons in Photographic Emulsions. H. J. Taylor. *Roy. Soc., Proc.* 150*A*. *pp*. 382–394, *June* 1, 1935.—α-Particles and protons give tracks in photographic emulsions, which are visible, after development, as rows of grains in straight lines. These tracks have been studied, using special emulsions more suitable for the work than those commercially obtainable. Exposure of a plate to a neutron source is found to give rise to well-defined tracks, which are due to the protons ejected by the neutrons in their passage through the gelatin of the emulsion. The uncertainties introduced by this method of investigation are considered, and the conclusion is reached that the method is unsuitable for determining the detailed distribution of neutron energies. Photomicrographs of the tracks are reproduced. AUTHOR.

2959. Theory of β-Rays and the Magnetic Moment of the Proton. G. C. Wick. *Accad. Lincei, Atti,* 21. *pp.* 170–173, *Feb.* 3, 1935.—By considering the proton to be continually dissociating and recombining according to the equation : proton $\rightleftarrows$ neutron + positron + neutrino, an explanation is sought of the discrepancy between the observed and theoretical values of the magnetic moment of the proton ($3\ \mu_n$ and $\mu_n = (e/2Mc)\ h/2\pi$, respectively). If the fraction of time in the dissociated condition equals τ, the average proton magnetic moment equals $(\mu_n + \tau\mu)/(1 + \tau)$, where μ is the mean magnetic moment of the dissociated states. The quantum mechanics of the process is discussed, and shown to lead to a value of τ of the right order to explain the observed nuclear moment. The theory is closely analogous to Fermi's theory of β-ray emission and certain difficulties in the latter are removed. W. S. S.

2960. Wave-Length of Secondary γ-Radiation. Kung Tsu-Tung. *Tsing Hua Univ., Sci. Reports,* 3. *pp.* 85–93, *April,* 1935. *In English.*—The absorption coefficient of the secondary γ-radiation associated with the anomalous absorption of ThC″ γ-rays was determined at the scattering angle 120° for the elements, Al, Zn, Sb, and Pb, by using a Geiger-Müller counter. The wave-length deduced from the absorption coefficient is 25·4 X.U. in the case of Al and Zn. For Sb and Pb there appears, in addition to the above component, a harder component of $\lambda = 13{\cdot}8$ X.U. The ratio of the number of hard-component quanta to that of soft-component quanta is 1 : 23 for Sb and 1 : 9 for Pb. The component of $\lambda = 25{\cdot}4$ X.U. is originated in the annihilation of positron with electron. The hard component can be interpreted as continuous X-rays produced by scattered electrons and positrons. AUTHOR.

2961. Determination of Minute Quantities of Radium, Radon and Thoron. Robley D. Evans. *Rev. Sci. Instruments,* 6. *pp.* 99–112, *April,* 1935.—The paper summarises the processes employed by the author in recent radium analyses. The methods of transferring the emanation from the samples are given and the application of double ionisation chambers and photographic recording to the analysis of weak samples are described. A flow method for the determination of thoron, more applicable to liquid samples than to solids is referred to. The paper concludes with a summary of the mean results of the analysis of certain classes of rocks, sea-waters and organisms. W. E. P.

***2962. Nomenclature for the New Counters for Ionising Radiations and Photoelectrons. H. Greinacher.** *Helv. Phys. Acta,* 8. 3. *pp.* 265–266, 1935. *In German.*—The general name " spark counter " is proposed for the new counters devised by the author [see Abstracts 3238 and 4138 (1934) and 2074 (1935)]. The arrangement with solid electrodes is to be called the " ordinary or solid spark counter," while those with liquid electrodes are to be designated by the adjectives " hydroelectric " or " liquid." The latter are further subdivided into " hydraulic " and " hydrostatic." The peculiar advantages of the different types are being investigated. L. A. W.

See also Abstracts 2781, 2783, 2784, 2799, 2923, 3079, 3120.

RADIATION.

COLORIMETRY.

2963. Personal Error in Colorimetry. R. A. Houstoun and A. J. Younger. *Phil. Mag.* 19. *pp.* 1107–1115, *June*, 1935.—Describes an investigation of the differences found for the trichromatic coefficients of five lights by two observers, using the vector method of colorimetry. The lights were the three C.I.E. standards, A, B and C, and standard A transmitted through two colour filters. Considerable differences in the coefficients were found although neither observer was colour-blind. The investigation was then extended by calculation, using the results given for the seven different classes of observers into which Coblentz and Emerson divided their 123 observers used to determine the luminosity (visibility) curve. Again the spread in the coefficients was large. J. W. T. W.

See also Abstracts 2988, 3024.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

2964. Kerr Effect of Chlor-Derivatives of Methane, Ethane and Ethylene. G. Sachsse. *Phys. Zeits.* 36. *pp.* 357–367, *May* 15, 1935.—Experiments were made using Otterbein's substitution method [see Abstract 1975 (1934)] to measure the benzene ring and its substitution polarisation ellipsoid for the aromatic compounds and to extend this to apply to the aliphatic compounds. Measurements and calculations are described in detail on the chlor-derivatives of methane, ethane and ethylene. From the results, the polarisation ellipsoids for the individual bonds $C - Cl$, $C - H$, $C - C$ and $C = C$ are calculated. The observed and calculated Kerr constants are in fairly good agreement. R. L.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2965. Ultra-Violet Fluorescence of Apatite. E. Iwase. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers No.* 567. *pp.* 1–9, *April*, 1935. *In German.*—The fluorescence spectra of 12 Japanese fluorites of various localities and a few from other countries have been taken with a fluid prism spectrograph. It appears that those specimens derived from metallic veins show broad bands, while those from basic volcanic rocks show narrow bands. The intensity is fairly high in the former but weak in the latter. There appears indeed to be a connection between the crystal form and the fluorescence; the plate-like forms giving the broad bands and the prismatic form the narrow bands. J. E.

2966. Fading of Polarised Fluorescence of Coloured Solutions. A. Jabłoński. *Zeits. f. Physik*, 95. 1–2, *pp.* 53–65, *May* 14, 1935.—It is shown that it is legitimate in the case of fluorescing solutions to make use of the conception of time of stay for the estimation of the results of fluorometer measurements. With support of Perrin's theory of depolarisation of fluorescence by thermal rotation of the colour molecule a theory of the fading of fluorescence is developed. The following conclusions are drawn: The fading of the fluorescence of solutions does not in general follow a simple exponential law and is different for different directions of the fluorescence light. The observed mean time of fading is in general not equal to the mean time of stay of the fluorescing molecule in the excited condition. In the case of polarised excitation and observation of fluorescence light perpendicular to the direction of vibration of the exciting light, only the component whose direction of vibration makes the angle 54·72° with that of the exciting light fades away exponentially. The mean time of fading of this component is equal to the mean time of stay of the molecule. The measurements of Szymanowski as qualitative experimental proof of the theory, and the possibility of quantitative proof with the fluorometer method are discussed. J. J. S.

2967. Photoelectric Cell in Study of Phosphorescence. W. H. Byler and A. C. Krueger. *J. Phys. Chem.* 39. *pp.* 695–699, *May*, 1935. —Three types of photoelectric cells were used in measuring the response of samples of phosphorescent ZnS to α-particle excitation. Difference in spectral response of the cells probably accounts for some differences in results. The photoelectric cell is readily adaptable to measurement of luminous intensity of phosphorescent substances and offers the advantages of simplicity and freedom from the personal element over the ordinary photometric method. AUTHORS.

2968. Luminescence of Fluorite and Other Minerals. H. Haberlandt. *Akad. Wiss Wien, Ber.* 143. 2*a*. 8–10. *pp.* 591–596, 1934.—A continuation of previous work [see Abstract 4878 (1933)]. A number of new fluorites showing radiophotoluminescence had been discovered and in two cases the presence of radioactive material has been detected. Fluorites with yellowish white photofluorescence had also been found in which the active impurity is of a bituminous nature. Some fluorites show the rare-earth lines in their spectrum before, and some after, heat treatment, but the majority of luminescent fluorites do not show rare earth lines at all. The existence of rare earths in fluorites depends on the origin and in general the colours of the luminescence depend on the mineral genesis as will be shown in a statistical survey. Uranium is often the active agent. J. E.

See also Abstract 3089.

INTERFERENCE. DIFFRACTION AND SCATTERING.

2969. Simplified Theory of the Michelson-Morley Experiment. R. J. Kennedy. *Phys. Rev.* 47. *pp.* 965–968, *June* 15, 1935.—It is shown that a correct application of Huygens' principle in the theory of the experiment leads to the same expression for the expected result as is derived in the simple classical theory. The effect due to path difference is shown to be the same as the effect derivable from the relative rotation of the interfering beams. Critics of the classical theory have mistakenly regarded the latter value as a compensating factor almost exactly offsetting the first. AUTHOR.

2970. Multiple Scattering by Small Particles. W. Trinks. *Ann. d. Physik*, 22. 6. *pp.* 561–590, *April*, 1935.—The effect on the intensity of scattering from a colloidal particle of a second similar particle in its immediate neighbourhood is investigated. In this connection, the problem of describing one and the same electromagnetic field by two different systems of polar coordinates (with origins in the two particles respectively) is first solved. It is found that serious changes are required in Mie's results when the two particles are immediately adjacent, but that these changes become negligible when the separation is greater than two or three particle diameters. The method solving the general case of any number of particles is indicated. C. B. A.

2971. Scattering of Light by Drops in a Wilson Chamber. C. G. Webb. *Phil. Mag.* 19. *pp.* 927–933, *May*, 1935.—Measurements by a photographic method were made of the light scattered at angles θ with the incident beam from 20° to 100° for water and alcohol-water drops formed in a Wilson expansion chamber. The drop-size was also determined from the rate of fall using Stokes' law and equalled $0 \cdot 96 \times 10^{-3}$ cm. (water drops), $1 \cdot 15 \times 10^{-3}$ cm. (alcohol-water drops). The scattered intensity dropped in the ratio of about 100 to 1 (water) or 50 to 1 (alcohol-water) in passing from $\theta = 20°$ to $\theta = 90°$, the absolute value being rather greater for the alcohol-water drops for angles in excess of 40°. W. S. S.

2972. Fine Structure of Rayleigh Scattering. L. S. Ornstein and P. H. van Cittert. *Physica*, 2. *pp.* 499–502, *May*, 1935. *In German.*—In this mathematical paper, which is a continuation of previous work [see Abstract 2057 (1935)], it is shown that small deviations from ideal lattice structure must give rise to scattering of light in all directions with unmodified frequency. The explanation advanced in the previous paper is now shown to be insufficient, in that the scattering with unmodified frequency to which it refers must be solely in the direction of reflection from the bounding surface of the scattering body. The present theory leads to the view that the central component of unmodified frequency must be particularly intense in the case of liquids. [See also Abstract 4056 (1934).] L. A. W.

See also Abstracts **2883, 2989, 2990, 2991, 3020, 3195.**

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2973. Reaction of Silver Ions with Gelatin. P. Wulff. *Zeits. f. wiss. Phot.* 34. *pp.* 59–62, *March*, 1935.—Conductivity measurements show AgCl to be more soluble in gelatin sols than in water, the increase in specific conductivity being proportional to the gelatin concentration; the conductivity of NaCl, on the other hand, is lowered by the presence of gelatin. Taking also the observation that if Ag_2O is added to iso-electric gelatin, one half of the silver is bound by the gelatin, while the other half remains free (regardless of the quantity of Ag_2O), the conclusion is reached that Ag^+ combines with two negative gelatinate ions to form a negatively charged complex ion. Assuming the validity of the mass-action law for such sols, the constant for such complex-formation is $K = [Ag^+] \cdot [Gel^-]^2/[(Ag\ Gel_2)^-]^2 = 2 \times 10^{-7}$, over the range in which Cl−concentration is a linear function of gelatin-concentration. Using known solubility products, $[Cl^-] = 0 \cdot 04[Gel^-]$ and similarly $[Br^-] = 0 \cdot 002\ [Gel^-]$. L. V. C.

2974. Characteristic Surfaces for Physical Development. H. Arens. *Zeits. f. wiss. Phot.* 33. *pp.* 281–286, *April*, 1935.—The characteristic surface for a photographic material is constructed in rectangular Cartesian coordinates with log exposure time (t) as x-axis, log intensity (I) as y-axis and density as z-axis. Taking (xy) sections the surface is represented in two dimensions by curves of equal density with log t as abscissæ plotted against log I as ordinates. In the region of normal intensity, the surface is of similar form for chemical development and for physical development either before or after fixation. At higher exposure (It) ranges, however, while chemical development shows solarisation whether obtained from a time-scale or an intensity-scale of exposure, physical development shows solarisation only on time-scale exposures, i.e., a given high density is in the solarisation region if derived from a time-scale, but in the pre-solarisation region if derived from an intensity-scale. L. V. C.

2975. Colour Sensitometry. J. Eggert. *Zeits. f. wiss. Phot.* 34. *pp.* 54–58, *March*, 1935.—Deals with the determination of the colour sensitivity by the DIN apparatus using a yellow filter, and considers the effect of different blue absorptions which occur with commercial yellow filters. The procedure consists of the measuring of the additional colour sensitivity of the photographic layer produced by sensitising, the characterising of the chosen yellow filter by means of its blue absorption, and the determination of the sensitivity loss (or of the prolongation factor) for the combination of the chosen layer and yellow filter from the two measured values. R. C. F.

2976. Production of Halogen Silver Gelatin Emulsions. B. Claus. *Zeits. f. techn. Physik,* 16. 4. *pp.* 109–115, 1935.—Describes a new method for the production of photographic emulsions, in which sedimentary halogen silver, particularly halogen silver produced free from binding material and subjected to physical and chemical processes, is dispersed in the emulsion substratum by means of ultrasonic vibrations, finally receiving an additional heat treatment. The results of an examination of the emulsions thus formed show that their emulsion and photographic properties are not inferior to those of the highest sensitivity silver-bromide gelatin emulsions produced by the usual methods. A comparison of this type of emulsion with the best commercial plates and films of the same grain size shows that it is superior with regard to sensitivity. [See also Abstract 1994 (1934).] R. C. F.

2977. Intermittency and Herschel Effects. C. C. Long, F. E. E. Germann and J. M. Blair. *J. Phys. Chem.* 39. *pp.* 721–725, *May,* 1935.—The interpretation of the Herschel and intermittency effects is briefly discussed on the basis of the familiar hypotheses of simultaneous forward and reverse reactions with accompanying photochemical lags. From a consideration of certain implications of these hypotheses a new effect is predicted. The existence of this effect—namely, that intermittent exposure to the " herschelising " light will be more efficient in producing Herschel effect than equivalent continuous exposure—has been amply proven by laboratory results employing three different wave-length bands of " herschelising " light. AUTHORS.

2978. Gaspar Colour Process for the Production of Subtractive Many-Coloured Pictures. B. Gaspar. *Zeits. f. wiss. Phot.* 34. *pp.* 119–124, *March,* 1935.—Subtractive colour photography is capable of giving coloured contact prints as well as transparencies, whilst additive colour photography can only be used for coloured transparencies. In spite of this advantage subtractive colour photography does not give results comparable with those obtained using the additive method, owing to the many variables which enter, and the process is a long and detailed one. The present author describes a new method whereby the subtractive method is made almost as simple as the normal black and white photographic process. After briefly explaining why the theoretical method suggested by Wall in his *History of Three-Colour Photography* fails, the suggested new method is then outlined. Many different colour-sensitive halogen silver emulsions are arranged above one another, forming an inseparable layer, the necessary quantity of dye or dye-producing substance for the picture production being added to each layer in a predetermined concentration. By exposure a picture impression is obtained in each of the layers, and these impressions are then changed to a coloured picture by simple chemical operations. The total thickness of all the individual layers should not exceed that of a normal layer, each of the layers being developed and immersed in other solutions without separation. Finally, the dyes or dye-producing substances, the dye-destroying solution which should act on all dyes to the same extent, and sensitisation are briefly discussed. R. C. F.

2979. Properties and Applications of Lenticular Films. G. Heymer. *Zeits. f. wiss. Phot.* 34. *pp.* 105–118, *March*, 1935.—A general account is given of the manufacture, properties and applications of this new product of the photographic industry. The film described is prepared from ordinary film by means of an engraving roller which imparts a lenticular form to the non-sensitive side of the film, which thus acts like a series of cylindrical lenses and gives rise to images on the sensitive layer beneath. The laws of image formation are considered theoretically and the dimensions (focal length and width) for Agfa and Kodak colour films are given. The application of the film to colour photography and the copying of coloured images and stereo pictures is described, together with its possibilities in colour kinematography. H. J. H. S.

2980. New Applications of Infra-Red Photography. J. Eggert. *Naturwiss.* 23. *pp.* 281–286, *May* 3, 1935.—Examples of recent applications of infra-red photography, depending mainly on selective transmission or reflection of infra-red light (7000–10,000 Å) by objects visually opaque or of similar colour, include studies of blood changes and subcutaneous structures, of leaf-diseases of plants and the microscopy of natural objects. L. V. C.

***2981. Examination of Photographic Shutters. A. Arnulf and Madeleine Schleeveis.** *Rev. d'Optique*, 14. *pp.* 1–17, *Jan.*, 1935.–Describes a method of examination of shutters which determines with precision the operation characteristics of the apparatus, whatever the complexity of action and form of shutter opening. The method consists of the determination of the curve of light flux passing the shutter as a function of time, and the determination of the light passing each point of the surface of the shutter during its operation. In the determination of the light flux curve the variations of the illumination of the image of a luminous slit are recorded on a rotating sensitive plate, the rays having passed through the shutter during its operation. Visual microphotometric methods are used to obtain values of the variations of the illumination. To determine the amount of light passing each point of the shutter, the shutter is uniformly illuminated and is photographed during its operation, the camera being focussed on the plane of the leaves of the shutter. Results obtained by the method are given for three different shutters. R. C. F.

***2982. "Photoflux" Flash Lamp. J. A. M. van Liempt and J. A. de Vriend.** *Rev. d'Optique*, 14. *pp.* 18–31, *Jan.*, 1935.—This new photo-flash lamp consists of a bulb containing a thin filament of a special material which is wound round another small filament coated with an inflammable paste. The gas in the bulb is oxygen at low pressure, so that on supplying the latter filament from a flash-lamp battery the inflammable material burns and causes the first filament to burn rapidly. In order to protect the user, should the lamp develop a leak in transit, a small blue disc of a cobalt salt is placed in each bulb which changes to a pale rose colour in the presence of water vapour. Two types of the "Photoflux" lamp are made and details of measurements carried out on the two types are given. The quantity of light emitted is 23,000 and 46,000 lumen-seconds for types I and II respectively, with an efficiency of 29·5 lumens/watt. From a measurement of the luminous intensity as a function of time it is found that the time-lag after completing the circuit is 0·05 sec. and that the time of burning is 1/35 to 1/50 sec. Finally, details of the colour of the light emitted are given. R. C. F.

***2983. Sources of Artificial Light for Photography. O. Reeb.** *Zeits. f. wiss. Phot.* 34. *pp.* 77–87, *March*, 1935.—Light sources fall into two groups, (i) constant-intensity sources (black-body radiators and gas-discharge tubes with or without filters), (ii) brief-duration sources (magnesium flash burners and "enclosed" flashlamps). For group (i), tables are given showing (*a*) colour temperatures and efficiencies of typical lamps, (*b*) discharge gases or vapours and filters for the isolation of monochromatic radiation in the ultra-violet and visible spectrum; such sources are suitable, e.g., for dark-room illumination. Data are given for the intensity-time relation and for the actinic value of light from the sources of group (ii). A scheme of definitions and units of actinic intensity, linked with the "Din 4512" specification, is proposed. L. V. C.

***2984. Pendulum Shutter for Continuous Exposure of Photographic Layers. R. Luther, G. Stade and W. Heider.** *Zeits. f. wiss. Phot.* 34. *pp.* 97–104, *March*, 1935.—A loaded sector disc capable of making a complete revolution under gravitational action is used to give time intervals on a photographic record of 1/1000 to 1/3000th sec. with an error of about ± 0·5 %. The interval is calculated by developing the equation of motion of the disc, allowance being made for friction, and is checked experimentally by means of a tuning fork. In the range used, agreement is found between the time and intensity scales. H. J. H. S.

See also Abstracts 2958, 3074.

PHOTOMETRY.

***2985. Brightness Difference Threshold Meter. B. H. Crawford and W. S. Stiles.** *Journ. Sci. Instruments*, 12. *pp.* 177–185, *June*, 1935.—An instrument for the evaluation of glare from light sources has been further developed and is here described in its final form. The method of use is described, with the necessary precautions. Results are given of a number of determinations with the glaremeter of the constants in the relation between glare effect (equivalent background brightness), glare intensity and glare angle. Values for the instantaneous probable errors of a single threshold reading and of a determination of equivalent background are deduced. The value for the probable error of a single reading agreed well with values found in other investigations by other methods. AUTHORS.

***2986. Thermoelectric Photometer. W. K. Green.** *J.O.S.A.* 25. *pp.* 190–194, *June*, 1935.—A thermoelectric photometer, designed and built at the Amherst College Observatory, is described. The instrument is much simpler and considerably less expensive than those which have been described by other authors. It contains a novel method for detecting and controlling variations in the intensity of the photometer lamp independently of the measuring galvanometer. Measures may be made more rapidly with this instrument than with the other types of thermoelectric photometers and the results are equally accurate. AUTHOR.

***2987. Simple Recording Microphotometer. N. B. Bhatt and S. K. K. Jatkar.** *Journ. Sci. Instruments,* 12. *pp.* 185–188, *June,* 1935.—A simple microphotometer utilising a photoelectric cell and bridge amplifier and a directly coupled recording camera is described. AUTHORS.

2988. Spectral Sensitivity, Theory and Applications. P. Rossier. *Arch. des Sciences,* 16. *pp.* 233–265, *Sept.–Oct.*: 304–338, *Nov.–Dec.,* 1934, *and* 17. *pp.* 34–43, *Jan.–Feb.,* 1935.—The author continues the astronomical applications of his theory [see Abstract 1583 (1935)]: effective wave-length for normal and prismatic spectra, colorimetry, indirect parallax, variation of atmospheric refraction with star temperature. The following section discusses a large number of methods of determining the constants of sensitivity of receivers and the published tables of absolute constants (Eddington, Bottlinger, Hertzsprung, etc.). The author gives more elaborate tables of absolute colour indices for temperature and spectrum type. The concluding section contains applications to the theory of incandescent illumination (change of efficiency with temperature, etc.), to the colours of incandescent metals, and to the blue colour of the sky. T. L. M.

See also Abstracts 2882, 3024, 3025.

POLARISATION.

2989. Depolarisation of Tyndall Scattering in Colloids. D. S. Subbaramaiya. *Indian Acad. Sci., Proc.* 1.*A. pp.* 709–715, *April,* 1935. —The depolarisation of the light scattered by colloids requires in general to be expressed by three measurements, namely, those of ρ_u, ρ_v and ρ_h where ρ indicates the ratio of the intensity of the weak to the strong component of intensity in the transversely scattered light and the subscripts $_u$, $_v$, $_h$, indicate respectively that the incident light is unpolarised, plane-polarised with the electric vector vertical, and plane-polarised with the electric vector horizontal. Measurements of ρ_u, ρ_v and ρ_h have been made for the following colloid systems: (1) Sulphur suspensions in water, (2) Castor oil emulsions in water, (3) Arsenious sulphide solutions in water, and (4) Casein solutions at various pH values. The results are discussed, and it is shown that the inter-comparison for the values of the three quantities furnishes more information regarding the size and the anisotropy of shape or structure of the particles than the measurement of any one or even two of the three quantities would have indicated. [See following Abstract.] AUTHOR.

2990. Depolarisation of Tyndall Scattering in Colloids. R. S. Krishnan. *Indian Acad. Sci., Proc.* 1.*A. pp.* 717–722, *April,* 1935.—An attempt has been made to obtain theoretically the relationship between the depolarisations ρ_u, ρ_v and ρ_h [see preceding Abstract]. The total scattering observed in the case of colloids and emulsions is divisible into two parts, (1) the scattering arising from the finite size of the particles assumed to be spherical and isotropic and (2) the scattering arising from the varying orientations of the actual non-spherical anisotropic particles. It is assumed that the law of distribution in direction of the orientation scattering by larger particles is the same as that for very small ellipsoidal particles. The following numerical relationship is then derived:

$\rho_u = (1 + 1/\rho_h)/(1 + 1/\rho_v)$. For arsenic sulphide sols, castor oil emulsions and sulphur suspensions, it is found that the formula obtained is in agreement with observations. In the case of protein solutions, however, anomalies are observed. The method of separating the scattering into two parts as stated, and of calculating the size of the particles from the observations is also indicated. AUTHOR.

2991. Nature of Unpolarised Light. R. T. Birge and L. A. DuBridge. *J.O.S.A.* 25. *pp.* 179–183, *June*, 1935.—R. T. Birge criticises the interpretation given by Langsdorf and DuBridge of the results of their experiment in which dextro-and lævo-rotatory solutions were placed in the two paths of an interferometer and destroyed the interference pattern [see Abstract 615 (1934)]. It is now shown that all their results can be correctly predicted on the basis of the simple Fresnel construction in which the incident unpolarised light is resolved in the polarising medium into two circularly polarised beams of opposite sense, without any assumptions as to the nature of unpolarised light. Other experimental arrangements are discussed, and it is concluded that no experiment can give any information on the nature of unpolarised light beyond that already known, namely, that if such light is split into components, in any given apparatus, no preferential polarisation will be found. In an attached note, DuBridge agrees with Birge's conclusions, and calls attention to relevent experiments by Wawilow and Brumberg [see Abstract 2951 (1933)]. C. B. A.

See also Abstract 2966.

RADIATION, EMISSION.

2992. Velocity of Propagation of Electromagnetic Energy. J. van Mieghem. *Comptes Rendus*, 200. *pp.* 1735–1737, *May* 20, 1935. —The propagation of electromagnetic waves in a uniformly ionised medium is examined mathematically. N. M. B.

2993. Selective Dispersion and Absorption of Radio Waves Produced by a System of Resonators. K. F. Lindman. *Ann. d. Physik*, 22. 6. *pp.* 591–608, *April*, 1935.—A large number of nearly closed copper wire rings of half wave-length, $\frac{1}{2}\lambda_0 = 13 \cdot 7$ cm., were arranged close together to form a prismatic system with a height of 40 cm., the sides enclosing the refracting angle being each 60 cm., and the base 30 cm. Investigation showed that radio waves sent through this prism in general experienced a deflection towards or away from the refracting edge of the prism according as the wave-length λ was greater or less than a wave-length λ^1, which was a little less than the natural wave-length of $2 \times 13 \cdot 7$ cm. When $\lambda = \lambda^1$ no deflection was obtained. The dispersion curve, which exhibits both normal and anomalous dispersion, agrees well with the theoretical curve calculated from the Ketteler–Helmholtz dispersion formula. It was also found that damped waves of wave-length 26 cm. sent through the prism were split into two components of different wave-length. An investigation with a large cylindrical lens of paraffin wax showed that the index of refraction $n = 1 \cdot 553$ was, in the range $\lambda = 16 - 33 \cdot 2$ cm., independent of the wave-length at least to the second decimal place. A. W.

2994. Hals Echo and the Ionosphere. J. Fuchs. *Hochfrequenztechn. u. Elektroakustik*, 45. *pp.* 111–117, *April*, 1935.—A critical review of the information about long-period echoes, up to 50 sec., observed in radio telegraphic transmission, with an examination of the possibility of the phenomenon arising in the F-layer. The collected data from a wide observation of signals from Daventry on 31·55 m. are given and deductions made therefrom, particularly with regard to the attenuation of the echo signal with respect to the delay, as well as the state of the ionosphere during the period of time covered. There are three most frequent times of echo reception, *viz.*, 9, 27, and 50 sec., and the shorter times are received at the greater distances; moreover, most echoes are received within the skip distance. Explanations are sought in the collision frequency of ions and the component of the wave in line with the earth's magnetic field. L. E. C. H.

2995. Mutual Influence of Two Electric Waves in the Heaviside Layer. K. Försterling. *Hochfrequenztechn. u. Elektroakustik*, 45. *pp.* 145–148, *May*, 1935.—Observation has shown that a modulated wave may give rise to modulation in a second wave, originally unmodulated. The question arises as to whether such an effect can be explained by our present assumptions as to the structure of the Heaviside layer. Discussion of this question leads to the conclusion that such an effect must, under certain conditions, occur if the conductivity of the lower Heaviside layer is due principally to free electrons. A. W.

2996. Application of the Magneto-Ionic Theory to the Ionosphere. H. G. Booker. *Roy. Soc., Proc.* 150*A*. *pp.* 267–286, *June* 1, 1935.—Approximate methods are employed to investigate vertical propagation in the ionosphere, regarded as a medium in which both the ionisation density and the collisional frequency vary slowly with height. It is found that propagation may, with due care, be described fairly completely with the aid only of the quasi-longitudinal and quasi-transverse approximations of the magneto-ionic theory. Friction imposes a lower limit to the frequency for which a wave can be gradually reflected from the ionosphere, although very long waves can be specularly reflected from the height where $c\kappa/p$ ceases to be small. A region of absorption can exist below the deviating region of the ionosphere and, for propagation through it at quite large angles to the earth's magnetic field, only the longitudinal component of the earth's magnetic field is effective. Near the magneto-ionic frequency there is never an appreciable extraordinary reflected wave. The dependence of relative absorption on frequency for very high frequencies is found to be different according as it takes place mainly in the non-deviating region or mainly near the point of reflection. No simple phenomenon which depends in a striking manner on the value of the " Lorentz term " has been brought to light. AUTHOR.

2997. Diurnal Variation of Cosmic Rays. A. Wagner. *Akad. Wiss. Wien, Ber.* 143. 2*a*. 8–10. *pp.* 533–561, 1934.—Considering the results of Hess and Steinmaurer [see Abstract 5295 (1933)] the author concludes that only by careful statistical analysis can the existence of variation of cosmic ray intensity with solar and sidereal time be established. In a summary of 8 points the author maintains (1) More precise correction for air pressure than has hitherto been made is essential if unequivocal results are to be expected; (2) the large variations occurring at the end of 10 day periods have no real existence; (3) larger values for the coefficient of absorption by air are required; (4) effects of changes in outer air temperature have been misinterpreted; (5) the existence of a solar variation can be shown satisfactorily by statistical analysis; (6) the maximum variation occurs somewhat before mid-day; the effect is more marked in summer and is probably due to vaporisation of water;

(7) the outer temperature coefficient of the apparatus may be deduced from the difference between the early readings when temperature equilibrium had not been established, and later readings; (8) readings over many years would be required to establish a variation with sidereal time. [See following Abstract.] F. C. C.

2998. Diurnal Variation of Cosmic Rays. V. F. Hess. *Akad. Wiss. Wien, Ber.* 144. 2a. 1–2. *pp.* 53–64, 1935.—In reply to Wagner's 8 points [see preceding Abstract] the author maintains (1) adequate correction for air pressure has already been made; (2) purely physical grounds show the real existence of a 10-day period in the barometer effect; (3) the hitherto accepted values for the coefficient of absorption of the cosmic rays in air are correct and larger values are not required; (4) changes in the outer air temperature do not necessarily prove the need for larger values of the absorption coefficient; (5) simple inspection of the curves shows the existence of a solar variation without recourse to statistical analysis; (6) the data require more careful analysis before definite conclusions can be drawn; (7) the temperature variations postulated by Wagner never existed; (8) the need for readings over several years in order to establish a variation with sidereal time had already been pointed out by previous workers. F. C. C.

2999. Diurnal Variation of Cosmic Rays. J. Clay and H. R. Woltjer. *Physica,* 2. *pp.* 582–584, *June,* 1935. *In English.*—There is no diurnal variation with sidereal time more than about 0·1%. Nova Herculis has not given a measurable radiation at the equator. AUTHORS.

3000. Cosmic Radiation and Nova Herculis. J. Barnóthy and M. Forró. *Zeits. f. Physik,* 94. 11–12. *pp.* 773–774, *May* 3, 1935.—Counter experiments performed by the authors show that the increase in intensity of the cosmic radiation observed daily during the flaming-up of Nova Herculis was not definitely greater than the daily variation observed before this event occurred. Kolhörster's conclusion, from his own experiments, that the Nova was a not improbable source of cosmic radiation [see Abstract 1595 (1935)] is considered unjustifiable. D. H. F.

3001. Cosmic Radiation and Nova Herculis. W. Messerschmidt. *Zeits. f. Physik,* 95. 1–2. *pp.* 42–45, *May* 14, 1935.—Ionisation measurements of unfiltered cosmic radiation, made with the fully compensated apparatus previously described [see Abstract 212 (1933)] during the time in which Nova Herculis belonged to the second to third magnitudes, show the presence of a 2·5 % increase in the intensity of the radiation over a range of ± 5 hours during the culmination of the Nova. When the Nova had waned to the 4th magnitude no such increase in intensity could be established. It is considered that an influence of Nova Herculis on soft cosmic radiation is definitely established, but that the conjecture that the totality of cosmic radiation is attributable to 50 to 100 Novæ is unjustified. J. E. K.

3002. Secondary Effects of Cosmic Rays. J. A. Priebsch. *Zeits. f. Physik,* 95. 1–2. *pp.* 102–114, *May* 14, 1935.—Using 3 tube counters arranged at the corners of an isoceles triangle, the dependence of triple coincidences on the thickness of absorbing sheets of Pb and Fe placed above the counters is examined at heights of 580 and 2300 m. above sea-level on the Hafelekar. For the same material corresponding curves were obtained at the two heights: the value deduced for the absorption coefficient of the primary radiation was 5×10^{-3}. The absorption of the softer secondary radiation, measured by placing absorber simultaneously above and between the counters, was less for Fe than would be expected from simple considerations of mass equivalence. While the counting of single particles was constant for a change in the arrangement of the counters, different results were obtained with "showers" according as the triangle rested on its base or apex. Experiments on the radiation proceeding from the scatterer at an angle greater than 90° to the incident direction receives adequate explanation on the scheme [see Abstract 1599 (1935)] of Geiger and Fünfer. F. C. C.

3003. Studies of Penetrating Radiation with a Wilson Chamber. F. Rieder. *Akad. Wiss. Wien, Ber.* 143. 2*a*. 8–10. *pp.* 499–502, 1934.—Using a vertical Wilson chamber in a magnetic field of 1500 gauss 160 electron tracks of the penetrating radiation on the Hafelekar (2300 m.) showed approximately equal numbers of electrons and positrons and the same energy distribution. About 30 of the tracks had energies greater thant 10^7 V. Tracks of heavy particles of range $0 \cdot 6$ to $5 \cdot 5$ cm. at S.T.P. were also registered. F. C. C.

3004. Statistical Determination of the Barometer Effect for Penetrating Radiation. J. A. Priebsch. *Akad. Wiss. Wien, Ber.* 144. 2*a*. 1–2. *pp.* 65–75, 1935.—A new method of statistical grouping is applied to give a more reliable formula for the evaluation of the barometer effect for penetrating radiation. F. C. C.

3005. Nature and Properties of Cosmic Corpuscular Rays. P. Auger. *J. de Physique et le Radium*, 6. *pp.* 226–228, *May*, 1935.—It is suggested that cosmic rays as they enter the atmosphere near latitude 45° consist of hard (D) and soft (M) groups, made up respectively of protons and electrons of energy 4×10^9–10^{11} eV, in the ratio 1 : 100, with coefficients of decrease $0 \cdot 7 \times 10^{-3}$ and 5×10^{-3} cm.^{2}/gm. The protons exhibit mass absorption, the electrons are largely stopped in a heavy element, *e.g.*, Pb (coefficient 35×10^{-3} cm.^{2}/gm.) with production of photons of short path and showers of electrons. This theory is shown to account for variations with altitude and latitude, absorption in various screens, production of secondary rays and showers, and recorded energy measurements. [See Abstract 1597 (1935) and following Abstract.] C. A. S.

3006. Absorption and Secondary Effects of Cosmic Rays. P. Auger and A. Rosenberg. *J. de Physique et le Radium*, 6. *pp.* 229–232, *May*, 1935.—A more detailed account of experiments already described [see Abstracts 1597 and 2529 (1935)], with in addition the result of replacing the 60 cm. thick layer of C by 30 cm. of Al, and of placing layers of Pb, Hg, Cu and Fe above the first counter. The results confirm the conclusion that while absorption of the more penetrating (D) component is mass, that of the other (D) component varies with the atomic number, absorption being complete with a few cm. Pb or Hg, but much less with Cu or Fe, and that this component is responsible for the showers [see preceding Abstract and following Abstract]. C. A. S.

3007. Absorption of Soft Component of Cosmic Radiation. P. Auger, L. Leprince-Ringuet et P. Ehrenfest. *Comptes Rendus*, 200. *pp.* 1747–1749, *May* 20, 1935.—The absorption of Pb, Sn, Cu and Al were measured for thicknesses up to 22 cm., using counters at an altitude of 3500 m. The authors consider that the incident radiation on the screens consist of two components [see preceding Abstract], and the absorption coefficients per gm.-atom of the soft component are deduced from these measurements. The values are found to be approximately equal to $2\cdot6z + 0\cdot058z^2$ where z is the atomic number of the atom. The result is discussed and it is suggested that the soft component is electronic, while the harder component probably consists of heavier particles. D. H. F.

3008. Effect of Filtration on the Properties of Shower-Producing Radiation. B. Rossi and G. Alocco. *Accad. Lincei. Atti*, 21. *pp.* 167–170, *Feb.* 3, 1935.—The increase in the number of coincidences observed when screens of Al, Sn and Pb were placed above the three tube counters was determined for three degrees of filtration of the primary cosmic rays, obtained by placing the apparatus at the top of the building, covering it with a lead sheet 7.5 cm. thick, and removing the apparatus to the ground floor. In the first condition the additional coincidences due to " showers " generated in the screens, increased to more than double in passing from Al to Pb. With the lead sheet or with the apparatus on the ground floor, the different screens gave more nearly the same shower effect. These results are consistent with the view that the cosmic rays contain two kinds of radiation, a softer component whose shower effect depends on the atomic number of the screen and a harder component producing the same shower effect independently of atomic number. W. S. S.

3009. Transformations of Cosmic Radiation in Matter. J. and P. H. Clay. *Physica*, 2. *pp.* 551–556, *June*, 1935. *In English.*—Between the secondary particles, produced in the piece of lead and the primaries incident, no correlation was found, hence the shower-producing radiations must be of a photon character. For the absorption-coefficient of the final corpuscular radiation 4 cm.^{-1} Pb was obtained. There are probably two photon radiations between the primary corpuscular and the final corpuscular radiation. [See Abstract 1600 (1935).] AUTHORS.

3010. Apparent Effect of Galactic Rotation on the Intensity of Cosmic Rays. A. H. Compton and I. A. Getting. *Phys. Rev.* 47. *pp.* 817–821, *June* 1, 1935.—Doppler effect studies of the globular clusters and the extragalactic nebulæ have shown a motion of the earth of about 300 km./sec. toward about declination 47° N. and right ascension 20 hr. 40 min., which is due chiefly to the rotation of the galaxy. Calculation shows that because of this motion the intensity of cosmic rays at sea level on an unmagnetised earth should be about 1·2 % greater on the front side than on the back. Taking into account the earth's magnetic field, it is estimated (assuming the cosmic rays reaching the earth to consist of protons and electrons) that the diurnal variation at latitude 45° due to this motion should be, within a factor of 2, equal to 0·1 %, with its maximum at 20 hr. 40 min. sidereal time. Data published by Hess and Steinmaurer show a sidereal time variation having just this amplitude and phase. While this agreement gives a strong presumption that the cause of this sidereal time variation is the earth's motion through space, another possible explanation is also considered. Experimental methods for making a definite test are outlined. The implication of a galactic rotation effect would be that the cosmic rays originate beyond our galaxy. AUTHORS.

3011. Spectral Distribution of Radiation from Three Reflector Units. B. T. Barnes. *J.O.S.A.* 25. *pp.* 167–168, *June*, 1935.—Gives the spectral distribution of the energy radiated in the wave-length range from 2950 to 27,000 Å for two sunlamps and one infra-red unit. The results obtained show that the sun lamps furnish considerable penetrating infra-red radiation, although designed primarily for supplying ultra-violet, the infra-red lamp being, however, a much more suitable source of penetrating infra-red and of visible radiations. [See Abstracts 3610 (1933) and 3422 (1934)]. R. C. F.

See also Abstracts 2983, 3077, 3101, 3195.

RADIATION, GENERAL THEORY.

3012. Neutrino Theory of Light. R. de L. Kronig. *Physica*, 2. *pp.* 491–498, *May*, 1935. *In German.*—On the basis of the relationship between neutrino- and radiation-fields formulated by Jordan [see Abstract 1602 (1935)], it is shown that for a given number of neutrons of each frequency the number of light quanta of each frequency has no definite value. A simple expression is obtained for the number to be expected, and it is shown that the neutrino-field cannot be determined unambiguously by the light quantum field. C. B. A.

3013. Corpuscles and Light Quanta. W. Glaser. *Zeits. f. Physik*, 94. 11–12. *pp.* 677–691, *May* 3, 1935.—The relativistic gas-theory of moving particles, constituting the basis of the Bose statistical theory is developed. Cases of complete degeneration are shown to be characterised by a maximum density which cannot be exceeded. Thermodynamic phase-equilibrium is established between "vapour" and condensate. In the case of particles of vanishingly small rest-masses the laws underlying the saturated ideal gas are the same as those governing radiation *in vacuo*. J. S. G. T.

See also Abstracts 2970, 2991, 3016, 3171.

RADIATION, MECHANICAL EFFECTS.

3014. Electrophotophoresis of Antimony. G. Isser and A. Lustig. *Zeits. f. Physik*, 94. 11–12. *pp.* 760–769, *May* 3, 1935.—The electrophotphoretic velocity of Sb particles increases similarly to the case of Te with increasing field-strength and tends towards a maximum value. Alterations of light intensity produce appreciable variations. Measurements at different gas pressures exhibit similar results to those for Te. It is concluded from the constancy of the electrophoresis at high field strengths, from the regular dependence on light intensity and from the presence of the effect in ultra-red light, that the interpretation of the phenomena as due to an ionic cloud surrounding the particle is not in accord with experiment. H. H. Ho.

REFLECTION. REFRACTION AND DISPERSION.

3015. Optical Constants of Rhenium and Gallium. H. Lange. *Zeits. f. Physik*, 94. 9–10. *pp.* 650–654, *April* 16, 1935.—By observing the state of vibration of light reflected from solid Re and Ga the optical constants are determined, according to Drude's formulæ, for the wavelengths 589 $m\mu$ and 436 $m\mu$ which were filtered out from a sodium lamp. By treating the surface in various ways the influence of the state of the surface on these constants is determined. The apparatus was tested by applying it and the measurement of the constants for He; good agreement was found with the results obtained by others. H. L. B.

3016. Quantum Theory of Metallic Reflection. L. I. Schiff and L. H. Thomas. *Phys. Rev.* 47. *pp.* 860–869, *June* 1, 1935.—A theory of metallic reflection in which the interaction of the light with the metal is expressed as scattering by the conduction electrons is developed.

The electric intensity perpendicular to the surface fluctuates widely within a few electron wave-lengths of the surface. This fluctuation can be used to improve the agreement between experimental and calculated values of the photoelectric effect at a clean potassium surface. The new theory predicts that the frequency at the peak of the spectral selectivity distribution curve of the photoelectric effect for a clean metal surface varies approximately as $N^{5/9}$, N denoting the number of free electrons per unit volume. J. S. G. T.

3017. General Formulæ for Refraction of a Light Pencil. F. Croze. *Comptes Rendus,* 200. *pp.* 1580–1583, *May* 6, 1935.—A simple geometrical demonstration of the general formulæ established by Sturm for the refraction of a pencil of light of infinitely small angular aperture at a dioptre of any regular form is given. C. B. A.

3018. Derivation of Snell's Refraction Law. A. Erdélyi. *Zeits. f. Physik,* 95. 1–2. *pp.* 115–132, *May* 14, 1935.—The following problem is investigated: In one of two semi-conducting media of infinite extent separated by a plane surface lies, parallel to the surface, an infinitely long linear light source. The radiation field of this source is to be determined. The errors inherent in previous treatments of the problem are discussed, and it is shown that an unambiguous solution can be obtained if (*a*) the use of plane waves is avoided and energy sources situated at finite distances only are admitted, and (*b*) only values different from zero are ascribed to the conductivities of the media carrying the waves. By applying boundary conditions, the transition to plane waves and non-absorbing media can then be made. C. B. A.

3019. Equivalent Refraction of Strong Electrolytes at High Concentrations. K. Fajans and R. Lühdemann. *Zeits. f. Phys. Chem.* 29. *Abt. B.*2. *pp.* 150–157, 1935.—The dependence of the apparent equivalent refraction of strong electrolytes on the concentration in dilute aqueous solution has been investigated for six electrolytes. For testing the additivity of the refraction for $C = 0$ and to deduce the separate values of the ionic refractions use has in some cases been made of the values obtained by extrapolation beyond $C = 1 \cdot 5$ equivalents in 1000 gm. of water. For 29 electrolytes the deviation of these extrapolated values from additivity is at most 0·04 c.c. and in the mean 0·014 c.c. and hence lies within the limits of uncertainty of the measurements and of the process of extrapolation. Certain examples show, however, that for higher concentrations neither the values of the equivalent refraction nor its variation with the concentration is in general additive. Data are given by **R. Lühdemann** (*ibid.,* pp. 133–149) for solutions of $CdCl_2$, Na_2SO_4, NH_4NO_3, $LiIO_3$, H.COONa, HI, HNO_3, HIO_3 and H.COOH. T. H. P.

***3020. Examination of a Parabolic Mirror with a Spherical Gauge. Yvonne Chatelain.** *Rev. d'Optique,* 14. *pp.* 41–61, *Feb.,* 1935. —The method consists in applying to different points of the parabolic mirror under examination a spherical gauge, of known curvature, which covers a known area of surface. The gauge and mirror are illuminated with monochromatic light, and fringes of equal thickness are obtained between the surfaces in contact. A calculation similar to that for Newton's rings gives the principal radii of curvature at each element of surface examined on the paraboloid. The focal distance of each element can then be determined and thence the aberrations of the mirror. These calculations are described in detail and the method is compared with that of Foucault. A description of the apparatus and some results obtained with it are given. C. B. A.

***3021. Instrument for Measuring the Optical Constants of Small Crystals. R. G. Wood and S. H. Ayliffe.** *Journ. Sci. Instruments,* 12. *pp.* 194–196, *June,* 1935.—A simple combination of microscope-stage goniometer and cell is described which enables the optical constants of small crystals to be determined accurately. The apparatus can also be used in the converse way to measure the refractive index of a drop of liquid, when it is out of the range of an ordinary refractometer. AUTHORS.

***3022. Optical Device to Aid in Mapping from Photographs. O. M. Miller.** *J.O.S.A.* 25. *pp.* 185–189, *June,* 1935.—A single-eyepiece oblique plotter enables level features such as coast lines to be drawn directly in plan from their perspective images appearing on high oblique photographs with the camera axis more nearly horizontal than vertical. Where the ground is not flat the position of points in plan and elevation was obtained by plotting the intersection of corresponding perspective rays from two photographs. The problem of focus and illumination, present in former patterns of stereoscopic plotter is eliminated here by the use of the pinhole mirror. The instrument is shown by photograph and diagram and its construction and method of operation described. It can plot and record direction to 2′ of arc and with further refinements this should be lessened. R. S. R.

***3023. Distortion-Free Mounted Lenses. J. Flügge.** *Zeits. f. Instrumentenk.* 55. *pp.* 193–201, *May,* 1935.—The new Busch " Winett " lens is described in detail. It consists of a plano-convex lens which, when placed at a fixed distance from an object with the convex surface toward the observer, gives an image which is free from distortion. The value of the fixed distance is calculated and tabulated for various lenses, and the advantages of this type of lens over those which are placed in direct contact with the object are enumerated. Conditions of illumination of the object are discussed. The best " mounted " lens is that whose glass thickness is equal to the distance of the plane surface from the object. C. B. A.

***3024. Optics : Optical Instruments, T. Smith ; Refractometry, J. S. Anderson ; Vision, J. Guild ; Colorimetry, J. Guild ; Photometry, H. F. Buckley.** *Phys. Soc., Reports, pp.* 131–160, 1934.

SPECTROSCOPY.

3025. Examination of Arc Spectra between Plain Soot Carbons and Candle-Power per Ampere of the Positive Crater. J. T. MacGregor-Morris and D. E. H. Jones. *Phys. Soc., Proc.* 47. *pp.* 667-677, *July,* 1935.—Analyses of arcs between plain soot carbons of various degrees of purity were carried out with a quartz spectrograph. The normal vertical two-electrode arc and also a horizontal three-electrode arc of *Y* form, with two negative carbons and one positive, were used, parts of the arc flame only being photographed. The object was to find a correlation between the spectra and the candle-power per ampere of the positive crater of the three-electrode arc. The effects on the spectra of the following changes in conditions are given : (i) changing the positive carbon while keeping the negative carbons the same ; (ii) special purification of the carbons ; (iii) sputtering of the arc ; (iv) photographing different parts of the arc (*a*) close to the positive carbon, (*b*) centre of the arc flame, (*c*) close to the negative carbons. Photographic enlargements of the ultra-violet parts of the spectra are given. AUTHORS.

3026. Spectra of Hg⁺ and Hg⁺⁺ (HgII and HgIII). T. S. Subbaraya. *Mysore Univ., J.* 7. *pp.* 100–134, 1933–1934.—Results of several previous investigations are discussed in relation to those of the author's studies, which have already been reported [see Abstract 232 (1933)] and are here described at greater length. Two further displaced series of Hg^+ states *m*T and $m^2D_{2\frac{1}{2}}$, are given, their series limits being excited states of Hg^{++}, namely $5d^9\ 6s^3D_3$ and one unclassified. The classifications of about 230 observed lines of Hg^+ are tabulated. The series limits are evaluated and discussed in relation to Hund's theoretical interpretations of the electron configurations and states. The above *m*T and $m^2D_{2\frac{1}{2}}$ states are interpreted as $5d^9\ 6s\ ns,\ {}^4D_{2\frac{1}{2}}$ ($n = 7, 8, 9, \ldots\ldots$) and $5d^9\ 6s\ ns\ {}^2D_{2\frac{1}{2}}$ ($n = 6, 7, 8, \ldots\ldots$) respectively, and Ricard's term R^3 [see Abstract 2435 (1932)] may be $5d^9\ 6s\ 7s\ {}^4D_{1\frac{1}{2}}$. For Hg^{++} it is concluded that the ground state is $5d^8\ 6s^2\ {}^1S_0$ rather than $5d^{10}\ {}^1S_0$, and that its term exceeds that of the hitherto known deepest state $5d^9\ 6s\ {}^3D_3$ by 33572 cm.$^{-1}$. The classifications of 45 observed Hg^{++} lines are tabluated. The ionisation potential of Hg^{++} is given as 26·1 volts. Despite McLennan, McLay and Crawford's analysis [see Abstract 1561 (1929)] demonstrating *jj* coupling, the author retains the idea and notation of *LS* coupling, to which type the lower states, in particular, approximate. W. J.

3027. Selenium Arc Spectrum, Se I. J. E. Ruedy and R. C. Gibbs; Reply by K. W. Meissner. *Zeits. f. Physik,* 94. 11–12. *pp.* 808–811, *May* 3, 1935.—This note by Ruedy and Gibbs (R. and G.) and reply by Meissner, published together, are concerned with discrepancies between the analyses of the arc spectrum of selenium as published on the one hand by R. and G. [see Abstract 5020 (1934)] and on the other hand by Meissner, Bartelt and Eckstein (M, B. and E.) [see Abstract 291 (1935)]. R. and G. consider the analysis of M., B. and E. to be erroneous; in particular they condemn the term-values given by M., B. and E. for $(^4S)\ 5p^3P_{012}$ and $(^4S)\ 4d^5D_{01234}$ and for all the terms based upon these. In his reply Meissner admits that, owing to insufficient data, the term-scheme of M., B. and E. is partially wrong; in particular is this true of all terms based upon the ^2D- and ^2P-limit of the ion and of some of the triplet terms based upon the ^4S-limit. He remarks further upon the lack of agreement between the numbers of lines observed by the different workers (due probably to the different conditions of excitation) and the discrepancies in the measured wave-lengths. L. A. W.

3028. Third Spectrum of Krypton (Kr⁺⁺). C. J. Humphreys. *Phys. Rev.* 47. *pp.* 712–717, *May* 15, 1935.—Of the lines due to various Kr ions, produced in tube discharges, and measured in 21-ft. grating spectrograms, 369 between λ7400 and λ2100 are assigned to Kr^{++}, classified on 88 levels and tabulated. The low states of Kr^{++} are $4s^2\ 4p^4\ {}^3P$, ^1D and ^1S, and the higher states are formed by the addition of an *s*, *p* or *d* electron to the $4s^2\ 4p^3\ {}^4S$, ^2D and ^2P states of Kr^{+++}. 68 of the 76 levels of the first excited states are established and their connection with the low states is determined by means of Boyce's short-λ data [see following Abstract]. Relative term values are accurately calculated from numerous inter-limit combinations and tabulated. Calculations based on the series $4p^3(^4S)ns\ {}^3S^\circ$, $4p^3(^4S)nd\ {}^3D^\circ$ and $^5D^\circ$ lead to an estimate of 298020 cm.$^{-1}$ for the lowest level $4p^4(^4S)^3P_2$, *i.e.* an ionisation potential of 36·8V. W. J.

3029. Spectra of Krypton in Extreme Ultra-Violet. J. C. Boyce. *Phys. Rev.* 47. *pp.* 718–720, *May*, 1935.—Previous work on these spectra is revised and extended as the result of new observations with increased dispersion and resolving power (2m. normal-incidence vacuum spectrograph). For neutral Kr no new lines are found but improved measurements of 10 classified lines between λ1236 and λ945 are given. For Kr^+ accurate data are tabulated for 82 classified lines between λ965 and λ559 including 31 newly identified. 138 lines of Kr^{++} between λ1924 and λ580 are identified and classified by consideration of Humphreys' work [see preceding Abstract] and tabulated. For Kr^{+++} one multiplet is provisionally identified and the investigation is being continued. W. J.

3030. Higher Terms in the Spectrum of Ag II. W. P. Gilbert. *Phys. Rev.* 47. *pp.* 847–850, *June* 1, 1935.—The spectrum of silver has been excited in a hollow kathode discharge with a helium atmosphere. Wave-length measurements were made in the region from 500 to 2600Å with a 1·5-m. grating vacuum spectrograph and in the region from 4000 to 11,000Å with a Zeiss 3-prism spectrograph. Starting with terms already reported by previous workers as a basis, radiations have been classified sufficiently to establish the $4d^9 6p\ ^{3,1}(P^\circ D^\circ F^\circ)$ and the $4d^9 7s$ and $8s\ ^{3,1}D$ terms. A few terms of unknown origin have been found and in addition a few lines arising from the transition $4d^9 5d$ to $4d^9 5p$ have been identified. The application of a Ritz formula to the $4d^9(^2D_{2\frac{1}{2}})\ ns\ ^3D_3$ series gives 134,110 cm^{-1} for the limit of this series. The absolute value of the $4d^{10}\ ^1S_0$ term with respect to the $4d^9\ ^2D_{2\frac{1}{2}}$ level of the Ag III ion is thus found to be 173,274 cm^{-1}, which corresponds to an ionisation potential of 21·4 volts. AUTHOR.

3031. Low Terms in Mn V and Fe VI. I. S. Bowen. *Phys. Rev.* 47. *pp.* 924–925, *June* 15, 1935. Most of the strong lines arising from transitions between the d^3 and $d^2 4p$ configurations in Mn V and Fe VI have been classified. The presence of forbidden lines of these ions in nebulæ and Novæ is discussed. AUTHOR.

3032. Resonance Radiation of Hg λ2536·7 without Doppler Broadening. S. Yen. *Helv. Phys. Acta*, 8. 3. *pp.* 225–246, 1935. *In German.*—The intensity of this line, emitted by a narrow beam of Hg atomic rays irradiated by a silica Hg lamp, is measured photoelectrically, the directions of primary radiation, atomic beam and observed resonance radiation being mutually perpendicular, and Doppler broadening thus avoided. The line is (i) very much absorbed by a cell of Hg vapour at various temperatures placed between atomic-ray and photoelectric cells, (ii) intensified by a weak magnetic field, applied across the atomic beam. The magnetic effect is described for four directions of the field (parallel and antiparallel to the primary radiation and to the direction of observation) both without and with a nicol prism between atomic-ray and photoelectric cells to separate the π and σ polarised components. W. J.

3033. Broadening and Displacement of Cæsium Series Lines by Krypton. C. Füchtbauer and H. J. Reimers. *Zeits. f. Physik*, 95. 1–2, *pp.* 1–5, *May* 14, 1935.—The broadening of Cs absorption lines $1s$–$10p$ and $1s$–$20p$ and the displacement of the lines $1s$–$8p$ and $1s$–$30p$ by means of Kr both approach a constant end value. The broadening is similar to that produced by A and Xe, and is towards the red, increasing without a maximum to a limiting value. The broadening shows strong asymmetry towards the red. The effective cross-section of Kr has been evaluated. W. R. A.

3034. Spectral Characteristics of Electrically Exploded Mercury. H. P. Knauss and A. L. Bryan. *Phys. Rev.* 47. *pp.* 842–844, *June* 1, 1935.—The spectrum obtained by sending 300 A from a 150 V generator through a small stream of mercury is found to be characterised by great broadening of many of the lines, and by a strong continuous background. In the region between 2537 and 1950Å, the continuous emission is strong enough, and sufficiently clear of emission lines, to be useful for absorption experiments. The continuous emission is ascribed to recombinations in which the kinetic energy plays a part, and the broadening of lines is ascribed to the strong electric fields of ions near the emitting atom. AUTHORS.

3035. Intensity Relations in Chromium Spectra. J. S. V. Allen and C. E. Hesthal. *Phys. Rev.* 47. *pp.* 926–931, *June* 15, 1935. —The relative intensities of lines in 4 multiplets in the spectrum of Cr I, 8 multiplets in the spectrum of Cr II, have been measured with a concave grating spectrograph and photographic photometry. The intensities in many cases deviate from those calculated for Russell–Saunders coupling, the deviations being in accord with observations of others on intensities in the spectra of elements of the iron group. Perturbing energy levels offer a possible explanation of many of the deviations. Two multiplets in the septet system of Cr II have been corrected for excitation. The temperature of the chromium arc source consistent with this correction was found to be 4060°K. AUTHORS.

3036. Nuclear Spins and Magnetic Moments of the Principal Isotopes of Potassium. S. Millman. *Phys. Rev.* 37. *pp.* 739–746, *May* 15, 1935.—The spin of the K^{39} nucleus and the hyperfine structure separation of the $^2S_{\frac{1}{2}}$ normal state are measured by deflection of an atomic beam in a weak unhomogeneous magnetic field [see Abstract 5029 (1934)]. The nuclear spin of K^{39} is found to be $^3/_2$ and the hyperfine structure separation of the normal state is found to be $0\cdot0152\pm0\cdot0006$ cm^{-1}. Using the modified Goudsmit formula the nuclear magnetic moment is calculated to be $0\cdot39$ nuclear Bohr magnetrons. The resolution suffices to indicate that K^{41} has a nuclear moment greater than $\frac{1}{2}$. The ratio of magnetic moments $\mu41/\mu39$ lies between the limits $0\cdot42$ and $0\cdot88$ depending on the spin of K^{41}. J. E. K.

3037. Class of Perturbations of Molecular Levels. G. H. Dieke. *Phys. Rev.* 47. *pp.* 870–876, *June* 1, 1935.—By following van Vleck and Kronig, the conditions for the occurrence of perturbations are investigated in detail for a simple case. Class A perturbations which are produced by the rotation of the molecule must have $\Lambda' = \Lambda \pm 1$. The vibrational levels cannot be perturbed in this case. There will be a constant shift between the rotational levels before and after the perturbations. When the electronic motion can be described approximately by the precession of a constant angular momentum about the figure axis, the components of the perturbation matrix can be completely calculated. For class B perturbations $\Lambda = \Lambda'$. The vibrational levels may be perturbed and there is no constant shift between the levels for high and low values of J. AUTHOR.

3038. Relative Transition Probabilities for Almost Closed Shells. C. W. Ufford. *Phys. Rev.* 47. *p.* 931, *June* 15, 1935.—Three simplifications are given for calculating the relative transition probabilities of different multiplets from spectroscopic stability. They apply to configurations involving almost closed shells in Russell-Saunders coupling. AUTHOR.

3039. Band Spectra of Diatomic Halides of B and Al. E. Miescher. *Helv. Phys. Acta,* 8.3. *pp.* 279–308, 1935. *In German.*—Mono-halide band systems developed in h.f. discharges through tri-halide vapours in tubes with external electrodes are investigated with dispersions of 50 to 1·85 Å/mm. Results of analyses of band-head data are:

Emitter	λ region	ν_e	ω_e'	$x_e'\omega_e'$	ω_e''	$x_e''\omega_e''$
^{11}B ^{35}Cl	2922–2598	36761·4	815·6	7·63	830·0	5·26
^{11}B ^{79}Br	3102–2848	33935·3	643·0	18·3	686·3	3·8
AlI	4749–4365	21889·3	337·2	2·0	316·1	1·0

for correlation with available data for AlCl and AlBr [see Abstracts 2515, 2904 (1934) and 1155 (1935)]. The expected isotope effects for B and Cl are present. No BI bands are found. The AlI system is $^3\Pi_{1,0}\rightarrow{}^1\Sigma$ and the other four are $^1\Pi\rightarrow{}^1\Sigma$, the $^1\Sigma$ being the ground state in every case. For BCl, BBr, AlCl and AlBr, the dissociation energies of $^1\Pi$ (obtained by extrapolation) are $D' = 6{\cdot}5_5$, $7{\cdot}0$, $6{\cdot}8_5$ and $3{\cdot}0$ V. respectively, and those of $^1\Sigma$ (obtained from D' and assumed dissociation products) are $D'' = 5{\cdot}1$, $4{\cdot}4$, $5{\cdot}3$ and $4{\cdot}3$ V. respectively. An energy level diagram for the halides (fluorides excepted) of B, Al, Ga, In and Tl is given. The r_e value for the $^1\Sigma$ state of each molecule of this group is estimated from a relation $r_e\omega_e\mu^{\frac{1}{2}}$ = a constant; the constant is evaluated from $r_e = 2{\cdot}1$Å for AlCl [see Abstract 747 (1935)]. W. J.

3040. Relationship between Absorption and Fluorescence Spectra in Dilute Solutions of Dye-Stuffs. W. L. Lewschin. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 474–482, *March* 11, 1935. *In German.*—The work now described is a continuation of previous experiments on the same subject [see Abstract 3742 (1934)]. The absorption and fluorescence spectra of crystalline eosine B extra in water, iso-amyl alcohol, and acetone solutions, of erythrosine extra in water, acetone: water, and acetone, and of rhodamine 6G extra in water and in acetone are measured quantitatively at 20°C. A marked change in the intensity of fluorescence accompanies change in solvent, whilst absorption and fluorescence spectra both become displaced, the displacement being unrelated to the dielectric constant of the solvent. The effect of temperature is also investigated. The change of fluorescence intensity with temperature is independent of concentration and of the nature of the solvent. The absorption of rhodamine G extra in iso-amyl alcohol decreases with increasing temperature, whilst that of rhodamine 6G extra remains unchanged. The temperature effects are therefore associated with the structure of the respective molecules. Corresponding and proportional changes are also observed in the fluorescence spectra of these solutions. C. B. A.

3041. Emission Spectrum of the CSe Molecule. B. Rosen and M. Désirant. *Comptes Rendus,* 200. *pp.* 1659–1661, *May* 13, 1935.—An emission spectrum attributed to CSe has been recognised in the spectrum of Se vapour in a tube containing traces of C. The Se contained traces of S, and an intense CS spectrum was also seen. The distribution of intensities is the same in both spectra, the analysis for CSe thus being facilitated. The separation of the branches is not so good as for CS, but there can be no doubt that the bands are due to the transition

$^1\Pi \rightarrow {}^1\Sigma$. A perturbation similar to that for CS is present in the earlier vibration levels of CSe. C. B. A.

3042. Infra-Red Absorption of Aqueous Solutions. A. Carelli. *N. Cimento*, 12. *pp.* 65–72, Feb., 1935.—Measurements on solutions of various salts show that the absorption band of water at about 3μ is influenced by dissolved salts in the same way as the Raman band. The latter has been found to be complex, and the same is probably the case with the infra-red band. The presence of ions in water modifies that constituent band of the 3μ group which is not related to the other two maxima, these being scarcely influenced in $NaNO_2$ and $NaNO_3$ solutions; such modification is specific to the ion present. A further proof of the interactions between the ions of solute and solvent is thus furnished. Examination of gypsum solutions shows that water of crystallisation although exhibiting the same characteristic maxima as liquid water, displays certain modifications. T. H. P.

3043. Influence of Temperature on the Absorption of Organic Liquids in the Near Infra-Red. B. M. Bloch and J. Errera. *J. de Physique et le Radium*, 6. *pp.* 154–158, *April*, 1935.—The influence of temperature on the spectra of hexane, benzene, acetone, chloroform, propylamine, aniline, some alcohols, and glycol chlorhydrin has been studied. The C – Cl, C = O, C – H, and N – H bands are not affected by temperature; the 1·6 O – H band shows large variations. The O – H and C – H bands of ethyl alcohol in CCl_4 solution obey Beer's law on dilution. W. R. A.

3044. Absorption Spectrum of Ozone in the Photographic Infra-Red. Lucie Lefebvre. *Comptes Rendus*, 200. *pp.* 1743–1744, *May* 20, 1935.—An extension of the work of Wulf [see Abstract 4005 (1930)] over the region 6500 — 10000Å. W. R. A.

3045. Infra-Red Absorption Spectrum of Silane. W. B. Steward and H. H. Nielsen. *Phys. Rev.* 47. *pp.* 828–832, *June* 1, 1935.—The spectrum of silane has been investigated to beyond 13·0μ. Bands, enumerated in the order of their intensities, were located at 11·0μ (910 cm^{-1}), 4·6μ (2183 cm^{-1}), 3·17μ (3153 cm^{-1}), 3·23μ (3095 cm^{-1}), 5·5μ (1820 cm^{-1}) and 2·3 (4360 cm^{-1}). Four of these regions have been investigated under higher dispersion and partially resolved. The spectrum appears quite similar, except for certain details, to that of methane and by analogy the above bands have been identified as ν_4, ν_3, $\nu_1 + \nu_4$, $\nu_3 + \nu_4$, $2\nu_4$ and $2\nu_3$. From these values ν_1 which takes the value 2243 cm^{-1} may be determined. By the methods developed by Dennison and Johnston the moment of inertia may be determined which from the most probable value for the spacing between lines takes the value $I_0 = 8{\cdot}9 \times 10^{-40}$ gm. cm^2. AUTHORS.

3046. Absorption of Acetylene and Di-Deutero-Acetylene in the Photographic Infra-Red. C. A. Bradley, Jr., and A. McKellar. *Phys. Rev.* 47. *pp.* 914–917, *June* 15, 1935.—Using an absorbing column 9 m. long of over 90 % pure C_2D_2 at a pressure of 85 cm., no absorption bands were observed in the region 7000 to 11,500 Å. This lack of absorption is discussed. A new absorption band of C_2H_2 is found with origin at 7859Å when an absorbing column 7·5 m. long at 90 cm. pressure is used. The possible vibrational transitions giving rise to this band are discussed. AUTHORS.

3047. Far Infra-Red Spectrum of H_2O. R. B. Barnes, W. S. Benedict and C. M. Lewis. *Phys. Rev.* 47. *pp.* 918–921, *June* 15, 1935. The absorption of atmospheric water vapour is mapped between 38μ and 170μ. The results are shown to be in good agreement with Mecke's analysis of the vibration-rotation bands, and permit an extension of his results. AUTHORS.

3048. Absorption Spectra of Salts of Mn, Co, Ni, Mo and W. J. Gielessen. *Ann. d. Physik,* 22. 6. *pp.* 537–560, *April,* 1935.—The absorption spectra of many Mn and Co salts and a few Ni, Mo and W salts are investigated under various conditions in glass and quartz-prism spectrographs of small dispersion (about 50 Å/mm. at λ7000 to 32 Å/mm. at λ3000). Some of the salts are used in solution and some in the solid crystalline form at room-temperature and/or at liquid-air temperature. In a few cases the salt is mixed and melted with an alkali chloride or a zinc halide in certain proportions and the crystalline mixture cooled to –189°C. when its absorption spectrum is photographed. The measured positions (in cm.$^{-1}$) both of the continua and of the narrow bands are given in tables and diagrams. Changes of widths and positions of the bands are noted as certain conditions are altered, *e.g.* (*a*) for solutions of different salts of the same metal, (*b*) for different crystalline salts of the same metal at the same temperature, (*c*) for a given crystal at 20° C. and –189° C. (*d*) for crystals of the same salt with different amounts of water of crystallisation, (*e*) for the same salt melted with different alkali chlorides, etc. W. J.

3049. Absorption Spectrum of Calcium Sub-Iodide. R. Samuel and M. Zaki-ud-Din. *Indian Acad. Sci., Proc.* 1*A. pp.* 723–726, *April,* 1935.—The sub-iodide was prepared in the manner used by Woehler and Rodewald, and consisted of yellowish brown crystals which were very reactive. These were heated in a silica tube to 1100° C. and the absorption observed using a continuous spectrum. Iodine bands or a pseudo-continuous spectrum were observed in the visible and an end-absorption in the ultra-violet. The latter is attributed to the sub-iodide. F. S.

3050. Absorption Spectrum of Benzene at High Temperatures. V. Henri and C. H. Cartwright. *Comptes Rendus,* 200. *pp.* 1532–1535, *April* 29, 1935.—The absorption bands A to H of benzene vapour are examined at various temperatures between 20° and 460° C. With increasing temperature, the fine structure disappears successively in H, G, F and E, and general absorption increases strongly. The original spectrum is reobtained, however, after irradiation for several hours at 460°, little decomposition occurring. The appearance of strong predissociation and general absorption above 170° C. together with the fact that thermal decomposition occurs at 600° C., shows that the effect is associated with a frequency less than 500 cm.$^{-1}$. This is discussed in relation to the results of other workers, and it is concluded that predissociation produces two C_3H_3 molecules which recombine to a large extent. C. B. A.

3051. Short Ultra-Violet Absorption Spectrum of Liquid Hydrogen Chloride. R. Tréhin and B. Vodar. *Comptes Rendus,* 200. *pp.* 1663–1665. *May* 13, 1935.—Liquid HCl has been examined between 2170 and 2816Å and the results are compared with those for aqueous solutions of HCl. [See Abstract 1039 (1933).] W. R. A.

3052. Absorption Bands Near the Principal Series Lines of Rubidium and Cæsium. Ny Tsi-Zé and Choong Shin-Piaw. *J. de Physique et le Radium,* 6. *pp.* 203–208, *May,* 1935.—Absorption bands are observed on the edges of the earlier members of the principal series of rubidium and cæsium and their wave-lengths and frequencies, with those of the lines, are tabulated. They are attributed to loosely bound molecules. The wave number differences between the bands and the neighbouring lines coincide well with the vibration transitions of the ordinary molecules Rb_2 and Cs_2. C. B. A.

3053. Ultra-Violet Absorption Spectrum of Ammonia. A. B. F. Duncan. *Phys. Rev.* 47. *pp.* 822–827, *June* 1, 1935.—The discrete absorption spectrum of ammonia has been photographed from 2300 to 850 Å. The experimental results of other workers in the long-wave portion of the spectrum are confirmed, and much new experimental data at shorter wave-lengths found. The bands down to 1665 Å are all diffuse because of predissociation. Below 1665 all the bands are very sharp and show rotational fine structure which is partly resolved. True continuous absorption (in distinction to that produced by pressure broadening) does not begin until about 1200 Å. At 1150 Å and below the continuous absorption is so strong that no more bands could be measured accurately. Sharp bands exist, however, at least as far down as 1085 Å, so the first ionisation potential should be at least 11·3 volts. The bands are classified in four v' progressions which fall in four different electronic states, all of the same type. All bands come from $v = 0$ of the normal state. Only one fundamental frequency appears in the excited states. AUTHOR.

3054. Analysis of Band Spectrum of Zinc. T. S. Subbaraya. *Indian Acad. Sci., Proc.* 1. *A. pp.* 663–667, *April*, 1935.—Known Zn_2 bands are analysed into systems similar to those recently proposed by the author for Hg_2 and Cd_2 bands in order to avoid difficulties of previous interpretations of the various band series as single v' progressions. Hamada's bands *νν* 27107–29308, Volkringer's *νν* 30582–32197, Volkringer's *νν* 32197–33514, and Mohler and Moore's *νν* 37925–39188 form systems A → X, B → X, C → X, and D → X. The states X, A, B, C and D are formed of $^1S_0 + {}^1S_0$, $^1S_0 + {}^3P_1$, $^1S_0 + {}^3P_2$, $^1S_0 + {}^3P_2$, and $^1S_0 + {}^1P_1$ respectively, and have vibrational frequencies of the orders 120, 850, 135, 85 and 200 cm.$^{-1}$ respectively for the lowest v values. As in Hg_2 and Cd_2 the successive vibrational intervals in the ground state X first increase and then decrease at about the same rate with increasing v. In Hg_2, Cd_2 and Zn_2 the intervals between the X level $v = 0$ and the $^1S_0 + {}^1S_0$ limit are 0·25, 0·18 and 0·10 V respectively, but may not represent the dissociation energies, since vibrational levels exist above the $^1S_0 + {}^1S_0$ limit; the matter is left undecided. W. J.

3055. Band Constants for N_2 Second Positive System. A. Guntsch. *Ann. d. Physik*, 22. 7. *pp.* 657–662, *May*, 1935.—B_v and D_v obtained for both $^3\Pi$ states by Büttenbender and Herzberg [see Abstract 1648 (1935)] greatly exceed those given by Guntsch. He therefore now describes his method and re-evaluates from the mean term differences used by those authors. He obtains practically the same B_v values as before, and replaces his original D_v values (admittedly only rough) by more exact ones which are still much smaller than Büttenbender and Herzberg's, the new figures being:

	B_e	B_0	$10^6.D_e$
Upper state – –	1·823	$1·813_8$	−4·8
Lower state – –	1·635	$1·625_0$	−4·2

The discrepancy is entirely due to difference in method. The rotational energy expression used by them includes a term $\epsilon(J + \frac{1}{2})$ which is rather large for all J-values, while that used by Guntsch includes a function

$\Phi(J)$ which is only appreciable for small J-values (<20). A note by **G. Herzberg** is appended. W. J.

3056. Absorption Spectra of Polyatomic Molecules Containing Methyl and Ethyl Radicals. H. W. Thompson. *Roy. Soc., Proc.* 150*A*. *pp.* 603–614, *July* 1, 1935.—The ultra-violet absorption spectra of a series of polyatomic molecules containing methyl and ethyl radicals have been measured. Whilst the majority are continuous from long-wave limits which are markedly affected by pressure, diethyl zinc, and diethyl mercury show systems of diffuse bands. An attempt has been made to analyse these and to construct schemes of energy levels. Connections are obtained with prominent Raman and infra-red frequencies. AUTHOR.

3057. Absorption Spectrum of Stannous Sulphide. G. D. Rochester. *Roy. Soc., Proc.* 150*A*. *pp.* 668–684, *July* 1, 1935.—An account is given of the absorption spectrum of SnS at temperatures up to 1200° C. The constants of the ground state X and of three excited states A, B, and C are tabulated below, in cm^{-1}:

Level	ν_e	ω_e	$x_e\omega_e$
C	33037·0	294·25	1·15
B	28337·9	331·9	1·25
A	23211·8	379·8	3·15
X	—	487·68	1·34

The system X → A has not been previously observed. The data for the other two systems are more extensive than those of Butkow and Tschassowenny and lead to sensibly different values for the vibrational constants. Several further progressions are recorded, but their precise relationship to the above systems is not clear. The intensity distribution in system B is similar to the "anomalous" distribution found in system A of the related molecule lead sulphide. Evidence relating to tin isotope effects is discussed. AUTHOR.

3058. Characteristic OH Band in Very Near Infra-Red. A. Naherniac. *Comptes Rendus,* 200. *pp.* 1742–1743. *May* 20, 1935.—Organic acids in the liquid state do not give an OH band. In the vapour state an intense OH band is found, double in $H\text{-}CO_2H$, and single in the other member of the series. The band is displaced towards longer wave-lengths by 200–300 Å. compared with the OH band in alcohols. This displacement is probably due to the large van der Waals forces in the acids. As the series is ascended there is a slight displacement toward the short waves. For glycol and glycerin the band is about 300 Å. wide; for the acids about 100 Å. wide, and of less intensity. The wave-lengths for the different substances are tabulated. [See Abstract 3306 (1934)]. W. R. A.

3059. Excitation and Emission in the Nitrogen Band Spectrum. G. O. Langstroth. *Roy. Soc., Proc.* 150*A*. *pp.* 371–381, *June* 1, 1935. —Further measurements [see Abstract 3857 (1934)] of the intensities of the second positive nitrogen bands, excited by electronic impact, have been made. This report includes results on 12 bands for various exciting electron energies between 14 and 160 eV. The relative intensities have been found to be independent of the accelerating potential above 30 V, and their dependence below this value is satisfactorily explained as an effect of the energy separation of the initial levels. It would appear to follow that there is little direct interaction between the exciting electron and the vibrating nuclei. The agreement of the relative intensities in

v'' progressions with the calculated emission probabilities is only approximate. This is also true of the agreement between the observed intensities of all measured bands and the predicted values obtained by combining the calculated excitation and emission probabilities. The discrepancies are believed to be due in part, if not entirely, to neglect of anharmonicity in the theroetical calculations. AUTHOR.

3060. Continuous Spectra. W. Finkelnburg. *Naturwiss.* 23. *pp.* 330–336, *May* 24, 1935.—The purpose of this survey is to review the numerous continuous phenomena in optical emission and absorption spectra and in X-ray spectra and to indicate how they may all be treated from a few fundamental unitary aspects and explained on the basis of a small number of elementary occurrences between molecules, atoms, ions and electrons. The significance of the results of continuous spectra investigations in various branches of physics, chemistry and astronomy is illustrated with a few selected examples. The survey falls naturally into four main sections: introduction, atomic processes, Auger effect and predissociation, electron processes. J. E. K.

3061. Absorption Spectrum of the Noble Gases Near the Limit of the Arc Spectrum. U. Fano. *N. Cimento,* 12. *pp.* 154–161, *March,* 1935. Rydberg's spectral terms of an atom are sometimes superposed on the continuous spectrum of a different configuration. A theoretical investigation is given of the effects of the interaction between the different configurations in a case of this type, and a formula is obtained which represents the distribution of the intensity of the absorption spectrum. Qualitative justification is given of some experimental results obtained by Beutler [see Abstract 1136 (1935)] in the investigation of the absorption in the arc spectra of the noble gases and the I^b spectra of some metallic vapours. J. J. S.

3062. Absorption of Light in Cæsium Vapour in the Presence of Helium. H. J. J. Braddick and R. W. Ditchburn. *Roy. Soc., Proc.* 150*A*. *pp.* 478–486, *June* 1, 1935.—The absorption of cæsium vapour has been measured in the presence of helium for helium pressures up to 20 cm. of mercury. The continuous absorption at every wave-length is reduced by the addition of helium. Helium at a pressure of about 3 cm. reduces the absorption to half-value at λ 3150, and helium at 2·0 cm. reduces it to half-value at λ 2250. The shape of the absorption curve near the series limit λ 3184 is altered and the maximum absorption is shifted to shorter wave-lengths. Certain data are given on molecular absorption in the region λ 3430–3530. This absorption is reduced nearly to zero in the presence of a small amount of helium. [See Abstract 672 (1934).] AUTHORS.

3063. Ultra-Violet Fluoresceuce Spectrum of Iodine Vapour. F. Duschinsky, E. Hirschlaff and P. Pringsheim. *Physica,* 2. *pp.* 439–448, *May,* 1935. *In German.*—Resonance spectra were excited in I_2 vapour at various temperatures and pressures by a series of lines between 1850 and 2600 Å. They appear to belong to a single band system whose lower level is the normal level of I_2, while the upper level varies with the potential at increasing distance from the nucleus. A second resonance series appears with each line above 2100 Å which is difficult to explain. F. S.

3064. Stark Effect in Absorption Bands of NO. G. Blet. *Rev. d'Optique,* 14. *pp.* 62–67, *Feb.,* 1935.—An account is given of experiments which were made in the hope of revealing a Stark effect in band spectra.

Under the conditions employed, with fields up to 18000 V. per cm., the widening of the 2260 Å band of NO due to a Stark effect, if it exists at all, is less than 0·02 Å. C. B. A.

3065. Influence of an Electric Field on the Absorption Spectra of Rubidium and Cæsium. Ny Tsi-Zé and Choong Shin-Piaw. *J. de Physique et le Radium*, 6. *pp.* 147–153, *April*, 1935.—The absorption spectra of Rb and Cs have been studied in an electric field varying from 260–1820 volts/cm. The number of lines observed in the principal series decreases as the field increases. Between the principal lines new lines, corresponding to the forbidden transitions S-D and S-S appear; these new lines are more intense in the spectrum of the light polarised parallel to the electric field. By application of the field lines of the principal series are displaced towards the red by an amount proportional to the square of the field; the lines arising from forbidden transitions are displaced towards the blue. W. R. A.

3066. Stark Intensities in a Canal-Ray Source. R. L. Thornton. *Roy. Soc., Proc.* 150*A*. *pp.* 259–266, *June* 1, 1935.—A new canal-ray tube is described which can be operated at 0·5 mm. pressure. It has been applied to measurement of relative intensities of Stark components of $H\beta$ and the helium group 2P–4Q. The electric field varies from 90 to 130 kV/cm. At 0·02 mm. the results show departure from theoretical σ components, but agree with Mark and Wierl's values. At 0·5 mm. a new intensity distribution of π components shows slight divergence from theory, while σ components. approach theoretical values. It is concluded that previous differences between canal-ray and lo Surdo sources are attributable to difference of gas pressure. F. S.

3067. Stark Effect for Mercury. R. N. H. Haslam. *Roy. Soc., Proc.* 150*A*. *pp.* 338–347, *June* 1, 1935.—The Stark effect for Hg in the region 2200 Å to 3000 Å has been examined in fields of 70,000 to 100,000 V/cm. Light from an electrically heated lo Surdo source was photographed with Hilger E_1 and E_2 quartz spectrographs. The displacements are in rather good agreement with a simplified theory, which is given. The moderate resolving power has permitted the resolution of some new combination lines. The values of the initial spectral terms are recorded. The main new feature of the investigation is the determination of the patterns of individual lines. These are abnormal. AUTHOR.

3068. Interpretation of the Raman Line 984 cm.$^{-1}$ of Benzene. O. Specchia and G. Scandurra. *N. Cimento*, 12. *pp.* 129–133, *March*, 1935.—Investigation was made of the Raman effect of benzene with a spectrograph of high dispersion with the object of examining the fine structure of the line 992 cm.$^{-1}$. Comparison between the intensities of the Raman lines 992 cm.$^{-1}$ and 984 cm.$^{-1}$ leads to a result in good accordance with the hypothesis of Gerlach and Grassmann which attributes the frequency of 984 cm.$^{-1}$ to an oscillation of the benzene nucleus in which for an atom C^{12} the isotope C^{13} is substituted. J. J. S.

3069. Vibrational Raman Scattering in Liquids. S. Bhagavantam and A. V. Rao. *Phys. Rev.* 47. *pp.* 921–923, *June* 15, 1935.—A quantitative investigation reveals that the distribution of intensity within the wings accompanying the vibrational Raman line 656 cm.$^{-1}$ in liquid CS_2 is very similar to that obtained in the wings accompanying the Rayleigh lines. The intensity starts from being a maximum at or very near the centre, rapidly falls off till a distance of 20 cm.$^{-1}$ is reached after which it gradually diminishes till it fades away altogether. These features are in marked contrast to the predictions of the existing theories of the rotational Raman effect. AUTHORS.

3070. Raman Spectra of Perchloric Acid and Nitrosyl Perchlorate. W. R. Angus and A. H. Leckie. *Roy. Soc., Proc.* 150*A*. *pp.* 615–618, *July* 1, 1935.—Raman spectra of 60 % perchloric acid, solid nitrosyl perchlorate, and solutions of nitrosyl perchlorate in perchloric acid of varying concentration have been obtained. The spectrum of nitrosyl perchlorate consists of the characteristic perchlorate ion frequencies, and a strong frequency of 2329 cm^{-1}. This is assigned to the NO^+ group, and is in good agreement with the value previously found for this group in nitrosyl sulphate. [See Abstract 2143 (1935)]. AUTHORS.

3071. Effect of Temperature upon the Raman Lines of Crystals. L. S. Ornstein and J. J. Went. *Physica,* 2. *pp.* 503–512, *May,* 1935. *In French.*—The ratio of the intensities of the Stokes and anti-Stokes lines of the Raman spectra of quartz ($\Delta\nu = 465$ $cm.^{-1}$) and calcite ($\Delta\nu = 156$ and 282 $cm.^{-1}$) are determined at about 20, 90 and 150° C. The results for quartz are in good agreement with the simple theory; but those for calcite show anomalies, which are discussed. It is also found that the intensity of the Stokes lines diminishes with increase of temperature, whereas according to Placzek's theory it should increase. The experiments show further that the frequencies of the lines diminish with rise of temperature, the variation being greatest for the lowest frequencies. These variations of frequency are considered to be connected with the thermal expansion of the crystals. The effect of change of temperature upon the form of the lines is also investigated. The calcite line 1088 $cm.^{-1}$ is unaffected, but the lines 282 $cm.^{-1}$ of calcite and 465 $cm.^{-1}$ of quartz show a broadening which is approximately proportional to the square root of the absolute temperature. L. A. W.

***3072. Automatic Measurement of Spectrograms. G. R. Harrison.** *J.O.S.A.* 25. *pp.* 169–178, *June,* 1935.—A device is described which can be attached to a moving plate comparator and which automatically records the passage of the density maximum of a line, computes the wave-length and records this value photographically. The three features can be used independently. Correct wave-length readings of standard lines can be fed into the machine or an empirical dispersion formula introduced. Errors due to backlash, oil film and temperature. are practically eliminated and setting is found to be more accurate than by hand. A 10- to 200-fold gain in speed of measurement is claimed. F. S.

3073. Spectroscopy: Band Spectra, R. W. B. Pearse; Infra-Red Photography, H. Dingle; Grating Theory, H. Dingle; Ultra-Violet Spectroscopy and Term-Analysis of Spectra, H. Dingle; Microphotometry, H. Dingle; Absorption and Fluorescence Spectra of Crystals, H. Dingle; Hyperfine Structure of Spectrum Lines, E. G. Jones; Historical Notes on Wave-Length Standards, C. V. Jackson; More Recent Progress in Wave-Length Standards, C. V. Jackson; Stellar Research, A. Hunter; Solar Research, A. Hunter; Instrumental Technique in Astrophysical Spectroscopy, A. Hunter. *Phys. Soc. Reports, pp.* 102–130, 1934.

See also Abstracts 2781, 2796, 2797, 2972, 2988, 3115, 3186, 3195.

VISION.

3074. Photography of the Eye. J. A. M. van Liempt. *Zeits. f. wiss. Phot.* 33. *pp.* 287–292, *April,* 1935.—Collects data on the pupillary diameter at different brightness levels, time variations of pupillary diameter in passing from dark to light or vice versa, eyelid and pupil reflex times, etc., and examines their bearing on portrait photography by flashlight. W. S. S.

See also Abstract 3024.

X-RAYS.

3075. X-Rays : Production of X-Rays, G. E. Bell ; Ionisation in Gases, I. Backhurst ; Absorption of X-Rays, I. Backhurst ; Scattering of X-Rays, I. Backhurst ; Measurement of Intensity, Quality, etc., W. Binks and G. E. Bell ; X-Ray Spectra, G. Shearer, and Continous Spectrum, G. E. Bell ; Applications of X-Rays, W. A. Wood. *Phys. Soc. Reports, pp.* 228–268, 1934.

3076. X-Rays from a Lenard Tube. F. Schmidt. *Phys. Zeits.* 36. *pp.* 283-288, *April* 15, 1935.—Recent historical research has suggested that Röntgen used a Lenard tube in his discovery of X-rays and not, as is generally supposed, a Crookes or Hittorf tube. A description is given of a tube identical with the one supplied to Röntgen in 1894. A number of experiments are described in which X-rays of fairly high intensities were produced by this tube. The evidence seems to confirm that of the historical investigations. J. E. R.

3077. Discharge Rays. G. Déchène. *Comptes Rendus,* 200. *pp.* 1577–1579, *May* 6, 1935.—In reply to Dauvillier [see Abstract 2921 (1934)], the author refers briefly to experiments confirming his previous observation of the production of discharge rays at atmospheric pressure. [see also Abstract 4130 (1933).] J. S. G. T.

3078. X-Ray Scattering Power of Silver. J. Laval. *Comptes Rendus,* 200. *pp.* 1605–1607, *May* 6, 1935.—The F-curve of Ag is determined with the aid of a double-crystal spectrometer. J. T.

3079. Auger Effect. L. Pincherle. *N. Cimento,* 12. *pp.* 81–92, *Feb.,* 1935.—Calculated the probability of radiationless transitions in which one electron falls from a higher level to fill a vacancy in the K or L level while another electron is ejected from the atom with the excess energy (Auger effect). The non-relativistic eigenfunctions of the H-like atom were used. The results obtained are compared with the relative intensities in the corpuscular spectrum observed by Robinson and Young for Mo, Zr, Sr and Cu, and show satisfactory agreement. The total fluorescent yield was also calculated and found to approximate to the experimental values for not too light elements. The ratio of radiational to Auger transitions varied as $Z^{3\cdot5}$ in better accord with experiment than the Wentzel result (Z^4). W. S. S.

3080. Fine-Structure of X-Ray Absorption Edges of γ-Alloys. R. Smoluchowski. *Zeits. f. Physik,* 94. 11–12. *pp.* 775–784, *May* 3, 1935.—It is shown that the fine-structure of X-ray absorption-edges can be calculated on the basis of Kronig's theory, for crystals with complicated lattice types. The theoretical results for γ-alloys (Cu_5Zn_8 and Ag_5Zn_8) are compared with the measured results, and a satisfactory agreement is obtained. Comparison of the results for γ-brass with those for β-brass shows that small atomic displacements have a big influence on the type of fine-structure exhibited. J. T.

3081. Intensity of X-Ray Reflection from Calcite. P. E. Tahvonen. *Soc. Scien. Fennica, Acta and Comm. Phys. Math.* 8. 6. [84 *pp.*], 1935.—Deals with the theory of X-ray reflection and summarises experimental results, with particular reference to calcite. The author's measurements of the integrated reflection ρA (Bragg) and ρB (Laue) for calcite, using MoKα-radiation are described. Twenty-four different reflections were studied in the case of ρA and twelve in the case of ρB. The values of ρA are compared with those deduced from W. H. Bragg's measurements. The calculated values of the effective absorption coefficient in the Laue experiments and the values of $\rho A/\rho B$ are discussed. W. E. P.

3082. Influence of Temperature on the Intensity of X-Ray Reflection from Silver. R. Andriessen. *Physica*, 2. *pp.* 417–424, *May*, 1935. *In English.*—By a photographic method the dependence of the Debye factor M upon temperature is determined for Ag in the region 18°—600°C. Up to 400°C. this dependence is approximately given by a straight line. For higher temperature a deviation of a straight line is observed which is presumably due to anharmonicity of the binding of the atoms in the crystal-lattice. AUTHOR.

3083. X-Ray Extinction in Piezoelectrically Oscillating Crystals. G. W. Fox and W. A. Fraser. *Phys. Rev.* 47. *pp.* 899–903, *June* 15, 1935.—The original work of Fox and Carr [see Abstract 3497 (1931)] on the effect of piezoelectric vibrations of quartz crystals on the Laue patterns has been continued and extended to include tourmaline and Rochelle salt. The effect of different surface conditions on the Laue patterns has also been studied. The results obtained for all three types of crystals were similar, though the effects were most pronounced in quartz. Quartz is undoubtedly the best material for the study of X-ray extinction in piezoelectric crystals. The increased blackening of the spots in a Laue pattern resulting from piezoelectric oscillation is explained as a consequence of decreased extinction brought about by the warping of the lattice planes during the vibration. AUTHORS.

3084. Intensities of the L-Lines of Gold. L. Pincherle. *N. Cimento*, 12. *pp.* 162–170, *March*, 1935.—The various causes that influence the relative intensities of X-ray lines are discussed in the case of the L-lines of gold. It is sought to give a quantitative valuation of each of the X-ray lines in order to be able to foresee theoretically the ratios of intensity between lines appertaining to different levels. J. J. S.

3085. Influence of Chemical Combination on the K$\alpha_{1,2}$-Doublet of Silicon. N. G. Johnson. *Zeits. f. Physik*, 95. 1–2. *pp.* 93–96, *May* 14, 1935.—The positions of the K$\alpha_{1,2}$-doublet of Si in the free element and in several compounds, are compared. In the case of all the compounds examined a shift of the doublet towards the short wavelength end is noted. The oxygen compounds show a fairly constant shift of about 2·4 X.U. For K_2SiF_6 a shift of 3·8 X.U. is observed. J. T.

3086. Effect of Chemical Combination on the Kβ_1 Lines of Sulphur, Chlorine and Potassium. J. Valasek. *Phys. Rev.* 47. *pp.* 896–898, *June* 15, 1935.—By using a special form of target, the Kβ_1 lines in the spectrum of the secondary X-radiation from a series of alkali halides and some alkaline earth sulphides have been measured. Combining the results with Stelling's values for the K-absorption edges, values are readily found for the electron affinities of Cl^- and S^{--} and for the ionisation potentials of K^+ as they exist in the respective crystals. Pauling's theory is used to reduce these values to those for the free ions. Good agreement with other data is obtained in the case of the chlorides, fair agreement in the case of the potassium compounds, and poor results in the case of sulphur. Possible causes for these discrepancies are suggested. The general method used in this work to obtain the spectra of compounds may find useful application in methods of chemical analysis by means of X-ray spectra. AUTHOR.

3087. X-Ray Evidence on the Ionic Arrangement in Thorium Nitrate Solutions. J. A. Prins and R. Fonteyne. *Physica*, 2. *pp.* 570–572, *June*, 1935. *In English.*—A quantitative study is made of the diameter of the diffraction halo with thorium nitrate solutions of different concentrations. The results are best accounted for by ascribing the principal halo to the arrangement of Th-ions. This arrangement is more regular than would follow from the available free space. If the ions are assumed to be heavily hydrated so as to form more or less a close-packed arrangement, good agreement with the experimental results is obtained. A less closely packed arrangement of the Th-ions (*e.g.* of the simple cubic or tetrahedral type) would give a less satisfactory agreement. AUTHORS.

***3088. Comparison of X-Ray Wave-Lengths by the Plane-Grating Vacuum Spectrograph, and the Structure of the K-Line of Carbon. D. P. R. Petrie.** *Phys. Soc. Proc.* 47. *pp.* 626–643, *July*, 1935.—The relative merits of plane- and concave-grating spectrographs for precise measurement of wave-length between 10 and 100 Å are discussed. It is shown that experimental conditions do not allow full advantage to be taken of the superior resolving-power of the concave grating. A plane-grating spectrograph was designed for relative wave-length measurements of high precision ; its dispersion and resolving-power are calculated, and a number of wave-length determinations relative to Cu $L\alpha_{12}$, *viz.* 13·310 Å, are reported. Microphotometer curves of the K-line of carbon show that this line has, besides the principal line, two components of shorter wave length. This result is in good accordance with that of other workers. AUTHOR.

3089. After-Effects of Fluorescent X-Ray Screens. P. M. Wolf and N. Riehl. *Zeits. f. techn. Physik*, 16. 5. *pp.* 142–148, 1935.—When considering the after-effect of a fluorescent X-ray screen the important factor is not the duration of the effect, but its intensity immediately after the X-ray tube is switched off. J. T.

See also Abstracts 2827, 3060, 3192.

HEAT.

CALORIMETRY.

3090. Specific Heat of Liquid Helium. W. H. Keesom and (Miss) A. P. Keesom. *K. Onnes Lab. Leiden, Comm.* 235*d. Physica,* 2. *pp.* 557–569, *June,* 1935. *In English.*—Measurements were made on the specific heat of liquid He under pressure and under its saturated vapour pressure. The principal change in specific heat at the λ-point occurs within an interval of 0·002° K., most probably even within 0·0002° K. A superior limit is indicated for the latent heat of transformation at the λ-point. The smallness of this limit considered in connection with the specific heat corroborates the conclusion of Keesom and Clusius that this latent heat is absent. A definite value is difficult to fix for the increase of the specific heat at the λ-point. The hypothesis is made that the shape of the He I branch of the specific heat curve must be ascribed to fluctuations due to thermal agitation, and in consequence the λ-transition in liquid He depends on the interaction between neighbouring atoms. These considerations of the influence of fluctuations are extended to other λ-phenomena (*e.g.*, ammonium halides, methane, etc.). From the form of the heating curves it is concluded that the heat conductivity of liquid He changes suddenly at the λ-point. AUTHORS.

3091. Atomic Heat of Nickel from 1·1 to 19·0°K. W. H. Keesom and C. W. Clark. *K. Onnes Lab. Leiden, Comm.* 235*e, Physica,* 2. *pp.* 513–520, *June,* 1935. *In English.*—The atomic heat of nickel was measured from 1·1 to 19·0°K. The atomic heat surpasses largely the heat capacity due to the atomic lattice, calculated from Debye's T^3 law with $\Theta = 413$. The additional heat capacity can, for the range 1·1 to 9·0° K, be represented by $C = 0{\cdot}001744T$. It follows another law and considerably surpasses the contribution that will be due to the interaction energy of the electrons that are responsible for ferromagnetism. The hypothesis is made that it is connected with the energy of the conduction electrons. The fact that it is many times larger than follows from Sommerfeld's formula for free electrons then shows that in the corresponding energy band, at least at the level of the limiting energy, the density of the possible energy states is particularly large. AUTHORS.

3092. Specific Heats of Zn, Mg and their Binary Alloy : $MgZn_2$. T. J. Poppema and F. M. Jaeger. *K. Akad. Amsterdam, Proc.* 38. 5. *pp.* 510–520, 1935.—The experimental results on the specific heats of these substances over a range of 0°–600° C. are presented. L. G. C.

***3093. Use of Dewar Vacuum Vessels in the Metal Block Calorimeter. F. M. Jaeger, R. Fonteyne and E. Rosenbohm.** *K. Akad. Amsterdam, Proc.* 38. 5. *pp.* 502–509, 1935.—The paper describes experimental improvements which allow the use of a Dewar vessel as thermal insulation for a metal block calorimeter in precision calorimetry of very high accuracy. L. G. C.

See also Abstracts 2824, 2869, 3101, 3103, 3121.

CONDUCTION.

3094. Thermal Conduction through Vapours. S. W. Milverton. *Roy. Soc., Proc.* 150*A. pp.* 287–308, *June* 1, 1935.—The thermal conductivities of the vapours of acetaldehyde and water have been determined, and their variation with both temperature and pressure investigated. A hot wire method has been employed, in conjunction with a thermostat system, and the development of a technique for similar vapours is described. The temperature and pressure ranges were such that the vapours were only slightly superheated. Under the conditions employed, it is found that the conductivity is not independent of pressure: Maxwell's law must be replaced by a linear conductivity-pressure relation. It is also shown that the more the vapours are superheated, the more nearly they obey Maxwell's law, but it is probable that the conductivity of every real gas increases slightly with pressure. The following empirical formulæ for the conductivities of the vapours, in terms of θ° C. and p, the pressure in cm. of Hg are obtained. For acetaldehdye vapour, for $\theta = 0$ to 100 and $p = 10$ to 30:

$$K = (238{\cdot}1 + (1{\cdot}426 - 0{\cdot}00315p)\,\theta + (0{\cdot}00428 + 0{\cdot}000017p)\,\theta^2 + 0{\cdot}430p) \times 10^{-7}\ \text{cal cm}^{-1}\ \text{sec}^{-1}\ \text{deg. C.}^{-1}$$

For water vapour, for $\theta = 70$ to 95 and $p = 10$ to near saturation value:

$$K = (359{\cdot}8 + 2{\cdot}170\theta + 3{\cdot}025p - 0{\cdot}0270p\theta) \times 10^{-7}\ \text{cal cm.}^{-1}\ \text{sec}^{-1}\ \text{deg. C}^{-1}.$$

AUTHOR.

3095. Influence of Cold Working of Metals on Heat Conductivity. G. Tammann and W. Boehme. *Ann. d. Physik*, 22. 5. *pp.* 500–506, *April*, 1935.—The percentage changes in the thermal and electric conductivities of metals subjected to cold treatment are found to be equal. It is also shown that rolling does not lead to anisotropy in the heat conductivity of the metal. H. L. B.

3096. Thermal Conductivity of Metals in the Form of Small Bars. A. Potop. *Comptes Rendus*, 200. *pp.* 1733–1735, *May* 20, 1935. —With reference to an electrical method previously described [see Abstract 3340 (1934)] for finding the conductivity of metals, errors in the coefficient of thermal exchange between the furnace and the metal bars, arising from imperfections in the shape of the latter and from incorrect mounting relative to the furnace, are discussed and precautions for their elimination are described. For silver containing 10 % copper the value 0·82 was found for the coefficient of conductivity, against 0·84 by classical methods. N. M. B.

See also Abstract 3101.

CONVECTION.

See Abstract 3101.

DILATATION.

See Abstracts 2844, 3104.

MELTING AND BOILING POINTS.

***3097. Boiling Point Apparatus for Lubricating Oils at Reduced Pressures. S. T. Schicktanz.** *Bureau of Standards, J. of Research*, 14. *pp.* 685–692, *June*, 1935.—This paper describes a boiling-point apparatus for lubricating oils and other compounds of high molecular weight at temperatures and pressures below their decomposition points. The temperatures are determined by means of three thermocouples located at different heights in the vapour column, which, by their differences in temperature, give some indication of the purity of the sample, the readings of the three thermocouples being identical for a pure substance. The pressures are determined with a McLeod gauge. Data are reported for pure di-*n*-butyl phthalate, for mixtures of di-*n*-butyl phthalate with 6·82, 10·62, and 18·75 mole per cent. of tri-*o*-cresyl phosphate, and for two lubricating-oil fractions obtained from successive distillations. AUTHOR.

3098. Physical Constants of Heavy Water. J. Timmermans and L. Deffet. *Comptes Rendus*, 200. *pp*. 1661–1663, *May* 13, 1935.—The melting points of D_2O at pressures of 1, 113, 241, 488, 726, 948, and 1051 kg./cm.^{2} are respectively 3·82°, 3·00°, 2·00°, 0°, –2·00°, –4·00°, and –5·00°. The curve connecting the two quantities is almost parallel to that for H_2O, but slightly less inclined. C. A. S.

3099. Liquefaction of Hydrogen by the Expansion Method. F. Simon, A. H. Cooke and H. Pearson. *Phys. Soc., Proc.* 47. *pp*. 678–683, *July*, 1935.—Descriptions of some experiments to liquefy hydrogen by the expansion method (*a*) by pure expansion, and (*b*) by the additional use of the Joule-Thomson effect. The yields are of such an order that it seems promising to build large hydrogen-liquefiers on this principle. AUTHORS.

3100. Speed of Sublimation and Condensation. K. F. Herzfeld. *J. Chem. Phys.* 3. *pp*. 319–323, *June*, 1935.—It has been assumed that in the simplest case every atom that hits a crystal surface of the same material condenses. The corresponding speed of sublimation has been calculated theoretically. The formula for the equilibrium pressure is changed in the case of atoms, if the electron weight in the gaseous state is different from the solid state. The influence of this fact on the speed of sublimation is discussed in the first part of the paper and it is shown that for true metals the speed of sublimation is probably increased, while for non-metals a reflection coefficient exists. For molecules the equilibrium pressure is higher than for atoms because in sublimation there is a transition from a limited oscillation of the axes to free rotation. It is made plausible that this results in an increased speed of sublimation but a finite reflection coefficient might also occur. AUTHOR.

See also Abstracts 3103, 3120, 3162.

TEMPERATURE, MEASUREMENT OF.

3101. Heat. J. H. Awbery. *Phys. Soc., Reports*, *pp*. 161–197, 1934.

See also Abstracts 2878, 3134, 3181.

THERMOCHEMISTRY.

3102. Salt Effect in Concentrated Solutions. Alteration of Heat of Solution of Potassium Chloride by Other Electrolytes. C. Drucker. *Arkiv f. Kem. Min. och Geologi*, 11*A*. *No*. 18. *pp*. 1–27, 1935. *In German*.—Tables are given showing the results of calorimetric measurements of the heat of solution of KCl (end concentration m_1 mol. per 100 mol. water) in water and in concentrated solutions of 28 different strong electrolytes (concentration m_2 mol. per 100 mol. water). The measurements are made at room-temperature and with various values of m_1 and m_2. The lowering of the heat of solution of KCl due to the presence of the strong electrolyes is found to be practically independent of m_1, but to increase with increase of m_2 in the experimental range, which is approximately $m_2 = 1$ to $m_2 = 10$. The different electrolytes give effects of different magnitudes. At $m_2 = 2$ the order of the chlorides (effect increasing) is H^+, Li^+, NH_4^+, Mg^{++}, K^+, Na^+, Ca^{++}; of the sulphates H^+, Mg^{++}, NH_4^+, Na^+; and of the nitrates H^+, NH_4^+, K^+, Na^+, Be^{++}, Mg^{++}, Ca^{++}, Ba^{++}. In the discussion it is concluded that the results cannot be explained by a simple removal of water by hydration, and no satisfactory theory can be found. L. A. W.

3103. Heats of Dilution and Vaporisation of $D_2O - H_2O$ Mixtures. E. Doehlemann and E. Lange. *Zeits f. phys. Chem.* 173. *Abt.* A.4. *pp.* 295–312, 1935.—Experiments are performed to ascertain if the heat of dilution of systems composed of isotopic molecules is zero or not. When heavy and light acetone are mixed it is zero, but on mixing D_2O and H_2O there is a heat absorption, the magnitude of which increases linearly with the D content. It is concluded that this heat is really due to the chemical reaction $H_2O + D_2O \rightarrow 2\,HDO$. The variation of the total partial molar heat of vaporisation for HDO and the so-called molar heat of vaporisation of the solution is determined and discussed. Observations of the dependence of the latter on concentration support the above conclusion. R. W. P.

3104. Heat Exchange in Metallic Transformations. H. v. Steinwehr and A. Schulze. *Phys. Zeits.* 36. *pp.* 307–311, *May* 1, 1935.—Following a recent paper on the heat exchanges occurring in β-brass during its transformations [see Abstract 2703 (1934)], additional results are obtained for Co, in which there are two transformations, an allotropic and a magnetic, the former taking place at 400 to 500°C. and the latter at a little above 1100°C. The same experimental method as that already described is used for Co of 98·1 % purity. It is found that the heat of transformation from the α- to the β-state is 0·1 cal./gm. (mean error ± 0·03 cal./gm.) and of the magnetic transformation 1·2 cal./gm. (mean error ± 0·07 cal./gm.); the transformation temperatures are given as 380 to 420° C. and 1,070 to 1125° C. respectively. H. J. H. S.

3105. Velocity of Shock Waves and Rate of Detonation of an Explosive. D. B. Gawthrop. *Frank. Inst., J.* 219. *pp.* 471–476, *April*, 1935.—Measurement of velocity of shock waves of explosions of widely different rates of detonation with reference to its influence on the ignition of inflammable gas mixtures. The velocity is found not to vary. A. S. C. L.

3106. Measurement of Pressure Developed by Explosives. P. Bernard. *Comptes Rendus*, 200. *pp.* 1728–1729, *May* 20, 1935.—Defining the " coefficient of increase," ρ, by the equation $P_v = (1 + \rho)P_c$, where P_v is the true pressure produced by an explosive under given conditions, and P_c that deduced from a crusher, ρ has been plotted against P_c for an explosive of vivacity of the order 10^4 tons/cm.^{2}, for two crushers: A, of length 13 cm. diam. 8 cm., with piston 1·2 cm.^{2}, and B, $4\cdot9 \times 3$ cm., and piston 0·12 cm.^{2} for crusher pressures $\ngtr$ 3500 kg./cm.^{2}. For A ρ decreases linearly from 9 % for $P_c = 1300$ kg./cm.^{2} to nil for 2700; for B it rises from 4 % for 1000 kg./cm.^{2} to a maximum of 17 % for 2900, and then declines to 12 % for 3500. C. A. S.

3107. Theory of the Catalysis of the Ortho-Para Transformation by Paramagnetic Gases. F. Kalckar and E. Teller. *Roy. Soc., Proc.* 150*A. pp.* 520–533, *July* 1, 1935.—The catalysis of the ortho-para transformation by paramagnetic gases is discussed. It is shown that the reaction velocity not only depends on the interaction energy between the nuclear moment and the magnetic field but also on the nuclear spin. The reaction can be used to determine the ratio of the magnetic moments of the proton and the deuton. This can be done with a high degree of accuracy by comparing the reaction velocities for H_2 and D_2 at the temperatures T and T/2 respectively, because then—neglecting minor effects—the two reactions can be correlated by a change of scale. AUTHORS.

3108. Relative Recombination Rates of Atomic Hydrogen and Atomic Deuterium. I. Amdur. *Am. Chem. Soc., J.* 57. *pp.* 856–858, *May*, 1935.—Using a dynamic method, the rates of recombination of atomic hydrogen and atomic deuterium have been measured under analogous conditions. The reaction velocity constant for the recombination of atomic hydrogen, k_H, is $(2 \cdot 05 \pm 0 \cdot 07) \times 10^{16}$ and that for atomic deuterium k_D, $(1 \cdot 51 \pm 0 \cdot 05) \times 10^{16}$ cc.^{2} mole^{-2} sec.$^{-1}$. The ratio of these rates, k_H/k_D, is $1 \cdot 36 \pm 0 \cdot 06$ indicating that the atomic diameters and interatomic forces are equal for hydrogen and deuterium atoms. AUTHORS.

See also Abstracts 3115, 3116, 3119.

THERMODYNAMICS.

3109. Fugacities of Ethyl Alcohol and Water in their Gaseous Mixtures. Deviations from Perfect Solutions. H. Essex and W. R. Kelly. *Am. Chem. Soc., J.* 57. *pp.* 815–816, *May*, 1935.—The molal volumes of twelve gaseous mixtures of ethyl alcohol and water, ranging in composition from zero to 99·83 % alcohol, have been experimentally determined at three elevated temperatures over a pressure range from one atmosphere to near the condensation pressure of water. From the smooth PV mole fraction curves, the deviations from the perfect solution have been calculated. At one atmosphere and in this temperature range, the solutions are substantially perfect. Those solutions for which the mole fraction of the considered component (alcohol in water $N_2 = X$ or water in alcohol $N_1 = X$ solutions) is greater than 0·2, deviate less than 2 % even at the maximum pressures recorded for each of the three temperatures.

AUTHORS.

3110. Diameter of the Curve of Densities [Represented as a Function of the Temperature]. E. Mathias. *Comptes Rendus*, 200. *pp.* 1643–1645, *May* 13, 1935.—Expressions representing the diameter of curvature of the curve of densities of gases, vapours, and liquids as a function of the temperature (including the critical temperature) are discussed. **Errata** *ibid. p.* 1892, *May* 27, 1935. J. S. G. T.

3111. Equation of State of Liquids. Negative Internal Pressure at High Temperatures. P. Weiss. *Comptes Rendus*, 200. *pp.* 1700–1702, *May* 20, 1935.—From a consideration of the isometric curves for a liquid it is shown that the internal pressure should decrease and become negative with increasing temperature as well as with increasing pressure. The results of Holborn and Otto for gases indicate that this change of sign occurs at about 200° C. for H_2 and between 300 and 400° C. for Ne, and it is suggested that the phenomenon is a general one. R. W. P.

***3112. Investigations on the Critical State. Part V. E. Schröer and G. Becker.** *Zeits. f. phys. Chem.* 173. *Abt. A.* 3. *pp.* 178–197, 1935.—A falling sphere viscometer is described which measures rapidly the relative viscosities of gases and liquids at high pressures and temperatures, with but small amounts of material, and with an accuracy of 0·5 to 1 % which has been checked by a photographic method [see also Abstract 690 (1930)]. By it the viscosity of diethyl ether has been measured in the critical and beyond the critical zone, *i.e.*, between 184·5° – 235° C. and at 25 – 75 kg./cm.^{2}, and its critical viscosity evaluated as $\mu = 0 \cdot 000475$ poise. The

isotherms of the kinematic viscosity become steeper with increasing pressure in the region of gaseous ether, while the isotherms of liquid ether run parallel to the pressure axis. The isotherms below the critical temperature are discontinuous at the liquefaction pressure, but continuous above it. Just above the critical temperature, the isotherms still exhibit two turning points which disappear with increasing temperature, and, at 215° are only just apparent, while at higher temperatures the isotherms become flatter in the transition zone. The critical kinematic viscosity is found to be $\nu = 0{\cdot}00182$. The dynamic viscosity is not a function of the density alone, although more determined by it than by temperature or pressure; and the greater the density the more pronounced is a negative temperature coefficient. A theoretical discussion is included to explain these phenomena. By means of a modified apparatus the viscosity of CO_2 at 20° and 101 kg./cm.^{2} has been measured and the liquid isotherms of the kinematic viscosity found to run parallel with the pressure axis.
H. H. Ho.

3113. Constants in the Equation of State of the Rare Gases. E. Brander and K. Tamminen. *Soc. Scien. Fennica, Acta and Comm. Phys. Math.* 8. 5. [6 *pp.*] 1935.—In an earlier paper [see Abstract 380 (1935)] Brander had obtained theoretical expressions for the constants *a* and *b* of van der Waals' equation, and had evaluated *b* for Ne, A, Kr and Xe at 0° C. The values of *a* for these gases are now calculated at this temperature, and compared with the experimental values derived by three different methods. R. W. P.

3114. Internal Equilibria in the Solid Phase. Part III. A. Smits. *Phys. Zeits.* 36. *pp.* 367–371, *May* 15, 1935.—Eucken's paper [see Abstract 798 (1935)] is criticised and the differences in behaviour between NH_4Cl and CCl_4 are pointed out; the only point of agreement is the hysteresis shown in the V : T curve. The need for investigating perfectly pure CH_4 by a static method is emphasised. [For Part II, see Abstract 382 (1935).] T. H. P.

3115. Free Energy of Sulphur Dioxide. A. R. Gordon. *J. Chem. Phys.* 3. *pp.* 336–337, *June*, 1935.—Values of $(F^\circ - E^\circ_0)/T$ for SO_2 are computed from spectroscopic data; the heat of formation of SO_2 from S_2 and O_2 is calculated from the calorimetric heats of formation of SO_2 and H_2S, and Cross' value for the energy of dissociation of H_2S. Equilibrium constants for the reactions $\frac{1}{2}S_2(g) + O_2 = SO_2$; $SO + \frac{1}{2}O_2 = SO_2$ are tabulated for the range 298·1 to 2800°K. AUTHOR.

3116. Thermodynamics of the System Sulphur Dioxide-Water. W. A. Roth. *Zeits. f. phys. Chem.* 173. *Abt.A.* 4. *pp.* 313–318, 1935.—The heat of solution (Q) of SO_2 in water is resolved into four constituents, *viz.*, (1) the heat of solution (Q_e) in the absence of hydration, (2) heat of hydration, (Q_h), (3) heat of primary dissociation, (Q_1), and (4) heat of secondary dissociation, (Q_2). Q is then written $Q = Q_e + \alpha_h Q_h + \alpha_1 Q_1 + \alpha_2 Q_2$ in which α_h represents the degree of hydration and α_1 and α_2 the respective degrees of primary and secondary dissociation. For the case of complete hydration, when the process of secondary dissociation can be neglected, the heat of solution, Q_1 should be a linear function of α_1; departure from linearity enables the degree of hydration in concentrated solutions to be determined. Data due to Roth and Zeumer enable α_h, $\alpha_h Q_h$, α_1, $\alpha_1 Q_1$, and $Q_e + \alpha_h Q_h + \alpha_1 Q_1$ to be determined over the range of concentration from N = 37·5 to N = 7500. Experimental and calculated values of $Q_e + \alpha_h Q_h + \alpha_1 Q_1$ agree to within 0·3 %. Values of the constituent thermal magnitudes, derived from direct calorometric determinations and from the reaction isochore are compared and a preference expressed for the former values. J. S. G. T.

3117. Thermodynamics of Ammonia-Water Mixtures. V. Fischer. *Forsch. IngWes.* 6. *pp.* 57–66, *March–April,* 1935.—Expressions for the quantities of state of an ammonia-water mixture are derived from the general expressions for those of mixtures of several constitutents. These are in good agreement with the experimental results of Baud and Gay for contraction of this mixture, and of Zinner for its heat of combination. The equilibrium isobars for 1 and 10 atmospheres are also calculated and give good agreement with the results of Clifford and Hunter and Wucherer. R. W. P.

3118. Physical Science of Heat. Part I. A. Eucken. *Die Physik,* 3. 2. *pp.* 63–90, 1935.—The following subjects are briefly discussed: fundamental principles of thermodynamics and statistical mechanics; equations of state; specific heats and entropy; the Joule-Thomson effect; two-phase equilibria; velocities of phase transformations; chemical heat tones and equilibria. A Bibliography comprising references to 52 papers is appended. J. S. G. T.

See also Abstracts 2824, 2847, 2885, 3101, 3103, 3121.

VAPOUR PRESSURE.

3119. Tonometry of Saline Solutions. J. Perreu. *Comptes Rendus,* 200. *pp.* 1588–1590, *May* 6, 1935.—In similar fashion [see Abstract 2194 (1935)] the vapour pressures of aqueous solutions of $BaCl_2$, $MnCl_2$ and $Na_2S_2O_3$ have been determined, and the solubility equations verified. The limit heats of solution are respectively − 5·11, − 4·81, and − 8·55 ca., all within 1·4% of the calculated amounts. Kirchhoff's equation for the differential heats of dilution is also verified for Na_2SO_4 at 15° and 25°, the error being about 6%. C. A. S.

3120. Vapour Pressure and Condensation of Radon at Low Temperatures. L. Wertenstein. *Roy. Soc., Proc.* 150*A*. *pp.* 395–410, *June* 1, 1935.—The behaviour of radon has been examined at low temperatures and the vapour pressure has been measured at different temperatures. The results show that the condensation of radon, as observed under the usual conditions of experiment, cannot be described as an equilibrium between the gaseous and the solid phase. It is shown in further experiments that the condensation of radon is usually a secondary effect due to the presence of condensible impurities, such as mercury, water vapour, etc. AUTHOR.

3121. Continuation of the Water-Vapour Saturation Curve above the Critical Point. M. Jakob. *Phys. Zeits.* 36. *pp.* 413–414, June 1, 1935.—Havliček has shown that the stipulation that the specific heat of water vapour at constant pressure should assume a maximum value as temperature is varied above the critical point leads to a smooth continuation of the saturation curve. It is shown that this corresponds to the conclusion of Trautz and Ader [see Abstract 2960 (1934)] that there is no marked deviation of the isochor for the critical volume, and that Eucken's assumption [see Abstract 4268 (1934)] of a continuation of the saturation limiting curve by means of the limiting curve of a phase transformation of higher order, in the sense of Ehrenfest, is in good agreement with Havliček's experimental curve. R. W. P.

See also Abstracts 2873, 3100, 3101.

ACOUSTICS.

3122. Frequency Pulling in Acoustics. H. Selberth. *Hochfrequenztechn. u. Elektroakustik,* 45. *pp.* 148–158, *May,* 1935.—Experiments with organ pipes and other sources of sound showed that the phenomena of frequency pulling occurred both when the frequency of the external source was nearly the same as that of the organ pipe used and also when the ratio of the frequency of the external source to that of the organ pipe was close to a value given by small whole numbers. Similar results were obtained with two similar organ pipes or other wind instruments. The latter part of the paper discusses the practical significance of the phenomena of pulling, in organs and also in the case of orchestras. It is concluded that the blowing of orchestral instruments in unison and, in the case of organ pipes, the production of accurately the same pitched note from pipes only approximately in tune, is to be explained by frequency pulling. A. W.

3123. Vortex Motion in Gaseous Jets and the Origin of their Sensitivity to Sound. G. B. Brown. *Phys. Soc., Proc.* 47. *pp.* 703–732, *July,* 1935.—The vortices produced by sound in jets of air are examined by stroboscopic kinematography, and their velocity, growth, and angular velocity are determined. It is found possible to explain the salient characteristics exhibited by sensitive jets and the mechanism of their sensitivity. The physical processes underlying the instability of gaseous jets in general are also discussed. AUTHOR.

3124. Grand Piano. W. Lange. *Hochfrequenztechn. u. Elektroakustik,* 45. *pp.* 118–128, *April, and pp.* 159–167, *May,* 1935.—A comprehensive study of the concert grand piano as a mechanical-acoustical energy converter. Means are described for measuring the motion and the energy given to the depressed key and to the hammer, the energy in the vibrating wire, its mode of vibration, the sound-energy output and its tonal quality. Distribution curves for the output sound-energy for uniform key pressure on all the keys of a number of pianos are given. The normal maximum sound-power output is about 1 mW.; loud playing raises this to about 6 mW. The decay factors of strings are also studied. L. E. C. H.

***3125. Acoustic Interferometer for a Wide Temperature Range. H. L. Andrews.** *Rev. Sci. Instruments,* 6. *pp.* 167–168, *June,* 1935.—A modification of the Pierce interferometer is described in which the velocity of sound in various gases at a frequency of 4 megacycles has been obtained for temperatures ranging from − 63°—150°C. with an accuracy of about 2%. The apparatus is self-recording, whereby, it is claimed, a greater accuracy is obtained. Anomalous variations with temperature of the velocity of sound in CO_2 as measured by the apparatus are stated to be in accord with theoretical predictions. J. E. R. C.

3126. Propagation of Sound to Great Distances. F. J. W. Whipple. *Roy. Meteorolog. Soc., J.* 61. *pp.* 285–308, *July,* 1935.—An account is given of the facilities at present available for investigating the propagation of sound in the upper atmosphere together with an analysis of the results obtained. The deductions which can be made as to the physical condition of the upper atmosphere are discussed and the relation between these and results obtained in other ways is traced. J. E. R. C.

3127. Sound, Covering the Years 1932 and 1933. E. G. Richardson. *Phys. Soc., Reports, pp.* 63–101, 1934.

3128. Effect of Pressure on Supersonic Dispersion in Gases. W. Railston and E. G. Richardson. *Phys. Soc., Proc.* 47, *pp.* 533–542; *Disc.*, 777, *July*, 1935. Measurements of wave-lengths have been made by inter-ferometer and hot-wire methods, and of absorption by hot-wire methods alone, for supersonic radiation at frequencies between 40 and 2000 kc./sec. in CO_2, N_2O and SO_2 at various pressures up to 2 atmospheres. For the hot-wire method, a circuit which gives a linear relation between amplitude or particle velocity and response at constant frequency is described. The velocity-measurements in the two former gases may be reduced to a common curve by plotting them against the parameter {frequency/pressure}; although the observed rise in velocity in the region where this parameter lies between 100 and 1000 is in accordance with the relaxation-time theory, the decrease in velocity at lower and higher values is not. In SO_2 the rise of velocity is in the neighbourhood of 4000. The absorption in all three gases rises sharply at pressures below 400 mm. of mercury. AUTHORS.

3129. Effect of Temperature on Supersonic Dispersion in Gases. H. L. Penman. *Phys. Soc., Proc.* 47, *pp.* 543–548, *July*, 1935.—Measurements of wave-lengths of supersonic radiation at frequencies between 40 and 140 kc. have been made in CO_2, N_2O and SO_2 at various temperatures from room-temperature up to 200° C. The velocities at constant density, i.e. reduced to 0° C. have been calculated. When these are plotted against temperature, supersonic dispersion is shown by a sharp fall of velocity in CO_2 at a temperature which increases with the frequency of the source. The significance of these results in the light of the theories of supersonic dispersion which have been propounded is then discussed. AUTHOR.

3130. Sound-Transmission Measurements. V. L. Chrisler and W. F. Snyder. *Bureau of Standards, J. of Research*, 14. *pp.* 749-765, *June*, 1935.—This paper gives a description of the equipment and method now used in making sound-transmission measurements at the National Bureau of Standards. Measurements are made at 9 frequency-bands covering a range from 128 to 4,096 ∼. The results of measurements on a number of floor and wall panels are given. In the case of floor panels the transmission of impact noises was also studied. Specifications for the construction of the various panels are appended. AUTHORS.

See also Abstract 3134.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstract 3143.

CONDUCTION AND DISCHARGE IN GASES.

3131. Electric Arc. H. Plesse. *Ann. d. Physik,* 22. 5. *pp.* 473–499, *April,* 1935.—The transition stage between the glow and the arc discharge is investigated by means of an a.c., the pressure, current and potential being appropriately chosen. Arcs are distinguished by the kathode spot being movable or stationary, according to the metal used as electrode. The spot moves in the case of Ag, W, Pt, Ni and Fe, and remains fixed in the case of Cd, Zn, Pb, Mg, Ca and C. It is shown that wherever metallic vapour forms sufficiently densely in front of the kathode a glow discharge transforms into an arc discharge. It appears that the production of vapour is not in every case due to heating, but that the impact of positive ions on the kathode may also lead to metallic atoms being ejected. H.f. vibrations are shown to occur in the transition stage between glow and arc discharge, the frequency varying from 10^5 to 2×10^6 according to the self-induction and capacity in the current circuit. The thermal data of the metals used as electrodes are found to account well for the respective tendencies of these metals towards the arc discharge. H. L. B.

3132. Starting of Discharge at a Spark-Gap Subjected to Radiation. W. Rogowski and W. Fucks. *Arch. f. Elektrot.* 29. *pp.* 362–370, *May* 18, 1935.—When account is taken of space charges in considering the starting of discharges at a spark-gap subjected to radiation, the discharge changes over to a self-maintained type for a definite finite current density. Calculation is made of the drop in the ignition potential due to the external radiation, and it is found that for weak radiation the lowering of the ignition potential is proportional to the square root of the current due to the external radiation. A. W.

3133. Tanberg Effect. F. Lüdi. *Helv. Phys. Acta,* 8. 3. *pp.* 272–278, 1935. *In German.*—The pressure on the kathode of a curved discharge tube has been attributed by Tonks [see Abstract 4284 (1934)] to electron pressure. It is shown that this assumption leads to incorrect values for electron density. J. E. R.

3134. Determination of Arc Temperature from Sound Velocity Measurements. Part I. C. G. Suits. Part II. H. Poritsky and C. G. Suits. *Physics,* 6. *pp.* 190–202, *June,* 1935.—A method of determining the temperature of an arc is described based on measurements of the velocity of sound in it. Allowance is made for the effect of ionisation upon the velocity. The velocity is measured by producing an intense spark in the arc and measuring the time (on a kathode-ray oscillograph) for the sound pulse produced to reach a detector. For the latter a second spark-gap was used, it having been found by the authors that the spark voltage rapidly increases when a pressure wave falls on the spark. By varying the arc length, end effects, etc., can be satisfactorily allowed for. The corrected temperature, which is independent of the arc current, is found for the copper arc to be 4100 ± 300° K. J. E. R. C.

3135. Theory of A.C. Corona Discharge. J. H. Bruce. *Phys. Zeits.* 36. *pp.* 341–342, *May* 1, 1935.—In a previous paper [see Abstract 2973 (1934)] the theory of d.c. corona due to Deutsch and Mayr was further developed and put on a firmer basis. The present paper gives the essentials of a quantitative theory of a.c. corona, the semi-heuristic theory of Holm being used as a basis. A comparison is made between the principal features of d.c. and a.c. corona discharges and the results previously obtained for the former are utilised in obtaining an integral equation applicable to a.c. corona discharges. A. W.

3136. Moving Striations in Neon-Gas at the Beginning of the Discharge. A. H. van Gorcum. *Physica,* 2. *pp.* 535–540, *June,* 1935. *In English.*—The positive column of a Ne discharge-tube was photographed with a rotating camera: (1) at the moment the discharge was started, (2) after short interruptions. The various stages are illustrated and discussed. AUTHOR.

3137. Total Ionisation of Slow Kathode Rays in Air. L. Freund. *Ann. d. Physik,* 22. 8. *pp.* 748–760, *May,* 1935.—The total production of ions in air at different pressures by kathode rays with velocities of 300 V and less is studied. The number and velocity of the exciting electrons as well as the number of ions produced are measured under accurately comparable conditions so that the effect on ion formation of the distribution of velocity caused by the residual gas is overcome. For electrons with energies of 300 to 100 V it is found that, on the average, about 30 V is required for every ion pair. For electrons with energies of less than 100 V, the energy required per ion pair rapidly increases. H. J. H. S.

3138. Positive and Neutral Rays. Part IV. Efficacious Sections by Neutralisation. A. Rostagni. *N. Cimento,* 12. *pp.* 134–153, *March,* 1935.—A description is given of an arrangement with transversal field for the measurement of efficacious sections by the neutralisation of ions in gases. The conditions of working are considered. The efficacious sections for the ions A^+, Ne^+, He^+ in the respective gases were determined at velocities between 900 V and 6 V. From the results obtained it was found that the efficacious section increases with decrease of the velocity from 900 V to 30 V, remains constant at a maximum value between 30 V and 20 V, and decreases towards lesser velocities. [For Part III see Abstract 835 (1935).] J. J. S.

See also Abstracts 2787, 2962, 2971, 3059, 3077, 3143.

CONDUCTION IN SOLIDS AND LIQUIDS.

3139. Discussion of the Transition Metals on the Basis of Quantum Mechanics. N. F. Mott. *Phys. Soc., Proc.* 47. *pp* 571–588, *July,* 1935.—The magnetic susceptibilities and electrical conductivities of Co, Ni and Pd and of their alloys with Cu, Ag and Au are discussed on the basis of the quantum theory of metals. It is shown that the number of electrons in the outermost *s* state must be about 0·6 per atom in the transition metals and one in the noble metals; certain magnetic properties of the alloys are explained on the basis of this fact. A quantum-mechanical explanation of the relatively high resistance of the transition metals is given and is shown to be supported by measurements of the resistance of alloys. AUTHOR.

***3140. Mains-Fed Valve Voltmeter. H. Pollatschek.** *Zeits. f. Elektrochem.* 41. *pp.* 340–344, *June,* 1935.—A description of filters, polarity indicators, iron wire resistances and stabilivolt used in supplying, from three wire d.c. mains, a valve voltmeter which has a stable zero, and will measure to ± 1 mV., taking less than 10^{-11} ampere from an instrument such as a H-ion cell to which it may be connected. W. H. W.

***3141. Two-Stage Amplifier for Small Alternating Voltages with Diode Rectification in the Output. F. Müller and W. Dürichen.** *Zeits. f. Physik*, 95. 1–2. *pp.* 66–71, *May* 14, 1935.—A description is given of a two-stage valve amplifier with high amplification which in the first instance was devised for photoelectric analysis with alternating light. It is especially characterised by a new kind of rectification of the output alternating voltage by means of a diode, and a high degree of sensitiveness can be obtained. J. J. S.

***3142. Amplifier for Photo-Cells. E. Einsporn.** *Phys. Zeits.* 36. *pp.* 347–356, *May* 15, 1935. *From the Reichsanstalt*—The relevant properties of special valves for the amplification of photo-cells are considered, and a suitable circuit for the measurement of photoelectric currents given. The calibration is described and as illustrations of its use measurements of the transmission of a transparent sample, and of the variation of intensity of a light source with the current supplied to it, are given in full. Measurements of the photoelectric output and of the dark resistance of a photo-cell are also given. D. H. F.

3143. Electric and Magnetic Measurements. L. Hartshorn. *Phys. Soc., Reports, pp.* 321–371, 1934.

3144. Electrical Resistance of Cadmium, Thallium and Tin at Low Temperatures. W. J. de Haas, J. de Boer and G. J. van den Berg. *K. Onnes Lab., Leiden, Comm. No.* 236*d*. *Physica*, 2. *pp.* 453–459, *May*, 1935. *In English.*—The "ideal" resistance curves of Cd and Sn (calculated by means of Matthiesen's rule) show a dependence respectively on about $T^{4.5}$ and T^4 (T = °Abs.). The "ideal" resistance of Tl is not to be represented by one single power of temperature, because of the faint S-form of the curve on a logarithmic scale. AUTHORS.

3145. Surface Waves in the Electronic Theory of Metals. A. W. Maue. *Zeits. f. Physik*, 94. 11–12. *pp.* 717–741, *May* 3, 1935.—The possibility is discussed that metallic electrons run along the metal surface as waves, and the relevant electron eigenfunctions are derived on this hypothesis. The reciprocity effects of the surface electrons with the lattice are discussed, and it is shown that at low temperatures ($T \ll$ Debye-temperature) transitions between surface states and electrons under the ordinary spatial conditions do not take place. For this special temperature region the contribution of the surface waves to the electrical conductivity has been evaluated. The surface conductivity is found to be of the dimensions of the usual conductivity of a monatomic metallic film. H. H. Ho.

3146. Phenomena of Supraconductivity. Olga Bertoli. *N. Cimento*, 12. *pp.* 93–119, *Feb.*, 1935.—A résumé is given of the work of K. Onnes and his collaborators on the effect of low temperatures, approaching absolute zero on the electric conductivity of metals and alloys. The effects of magnetic fields and electric currents are noted and also the change in the critical point for a.c. of high frequency. Other properties of supraconductivity are mentioned briefly. H. M. B.

3147. Supraconductivity of Alloys. C. J. Gorter. *Physica*, 2. *pp.* 449–452, *May*, 1935. *In English.*—The paper suggests a possible explanation of the behaviour of many supraconducting alloys which according to recent measurements is very different from that of pure metals. The experimental results on pure metals can fairly well be described on the assumption in some cases of the simultaneous existence of supraconductive and normal regions in equilibrium and the paper suggests that the recent results found for alloys need not be in disagreement with this general explanation. R. L.

3148. Electrical Phenomena at Extremely Low Temperatures. J. C. McLennan. *Phys. Soc. Reports, pp.* 198–227, 1934.

3149. Variation of Conductivity of Metallic Films. M. Pierucci. *N. Cimento,* 12. *pp.* 73–75, *Feb.*, 1935.—Recent experiments on silver by A. Deubner [see Abstract 4305 (1934)] agree fully with those of the author [see Abstract 3869 (1934)] on tungsten. They confirm the existence of an effect of the electric charge on the conductivity of metallic films, reversible, symmetrical with respect to the sign of the charge, of the sign and of the order of magnitude found by the author. J. J. S.

3150. Electrical Conductivity of Metallic (Cu–Pt) Mixed Phases at Low Temperatures. H. J. Seemann. *Zeits. f. Physik,* 95. 1–2. *pp.* 97–101, *May* 14, 1935.—Continuing previous work [see Abstract 1702 (1934)] the electrical resistance of mixtures of Cu and Pt containing 70 and 75 % of Pt respectively was determined from room-temperatures to 20° Abs. The metals were first subjected to regular heat treatment and an observation made between temperatures of 400°C. and 550°C. showed that the specific resistance differed from that at room-temperature, corresponding to the formation of a mixed phase with regular cubical structure. The 75% Pt mixture showed a simple linear relation between resistance and temperature, its behaviour being similar to the previously investigated Cu_3Pt mixture. With the 70% Pt mixture the relation between resistance and temperature was approximately linear down to 75° Abs., after which the curve dropped rapidly. This anomalous phenomenon probably has its origin in the ferromagnetic properties of the mixture. F. C. C.

3151. Conductance of Aqueous Electrolytes. T. Shedlovsky, A. S. Brown and D. A. MacInnes. *Am. Electrochem. Soc., Trans.* 66. *pp.* 165–178 ; *Disc.*, 178, 1935.—With new data for solutions of various chlorides, Onsager's equation is shown to be correct for very dilute solutions of strong electrolytes, the results at higher concentrations being accounted for by semi-empirical equations of the former indicated by Onsager's approximations. The dissociation of chloroacetic acid solutions has been measured by a method allowing for changing ionic mobilities, and ionic activities are calculated from the Debye–Hückel equation. The results give a value of the thermodynamic ionisation constant which holds to a concentration as high as that for which the assumptions made are valid. Thus the interionic attraction theory is useful in interpreting data for both strong and weak electrolytes. T. H. P.

See also Abstracts 2806, 2973, 3095, 3161.

DIELECTRICS AND CAPACITANCE.

3152. Polarisability of H_2^+. G. Steensholt. *Zeits. f. Physik,* 94. 11–12. *pp.* 770–772, *May* 3, 1935.—Unsöld [see Abstract 259 (1928)] has already attempted to evaluate the average polarisability of H_2^+ from a consideration of the disturbance between a H-atom and a H-nucleus and the influence of the proton field on the polarisability of the atom, and the present author now supplies an alternative calculation based upon a method due to Hylleraas [see Abstract 734 (1931)] which derives the eigenfunction of the ion in the electric field. H. H. Ho.

3153. Constancy of Two Dipole Moments in the Vapour State and their Apparent Variation in Solution. C. P. Smyth and K. B. McAlpine. *J. Chem. Phys.* 3. *pp.* 347–350, *June,* 1935.—The validity of the solution method for the determination of dipole moment is considered with particular reference to the possible variation of moment with temperature. The moments of heptyl bromide and butyl chloride in the vapour state are found to be 2·07 ± 0·05 and 2·04 ± 0·01, respectively, which show the absence of appreciable increase in moment in the normal alkyl chlorides and bromides with increase in the length of the carbon chain beyond ethyl. Consideration of these values together with data for the alykl halides in solution leads to the following estimated moment values for the vapour state: *n*-propyl bromide and *n*-butyl bromide, 2·04 ± 0·03; *n*-propyl iodide and *n*-butyl iodide, 1·93 ± 0·04. AUTHORS.

3154. Dielectric Properties of Heavy Water. P. Abadie and G. Champetier. *Comptes Rendus,* 200. *pp.* 1590–1593, *May* 6, 1935.—The dielectric properties of heavy water were determined as follows: Dielectric constant $\epsilon = 79$ at 20°C. for wave-length of 100 m.; Electric moment, $\mu = 1 \cdot 87 \times 10^{-18}$ e.s.u. Anomalous dispersion, determined by solution in dioxan, showed a small upward displacement of the maximum of the relaxation time when plotted against concentration of solution. A. M. T.

3155. Dielectric Properties of Alcohols and Ether in Various Solvents. F. H. Müller and P. Mortier. *Phys. Zeits.* 36. *pp.* 371–377, *May* 15, 1935.—Values of the molecular polarisation at infinite dilutions of a number of dipole substances form a smooth curve when graphed against the dielectric constant of the solvent. These substances satisfy the equation of Arkel and Snoek for the variation of molecular polarisation with concentration. Alcohols and ethyl ether do not give results in agreement with this equation; they show maxima and minima instead of the continuous decrease of polarisation with increase of concentration. The present report describes results of determinations of the polarisation at infinite dilutions of alcohol and ethyl ether, in various solvents; they verify the view that these substances should also show deviations in this respect, when the results are considered as functions of the dielectric constant of the media. Liquids used as solvents were C_6H_{14}, $C_{10}H_{18}$, CCl_4, C_6H_6 and CS_2. The results obtained were as anticipated, since the polarisations at infinite dilutions were appreciably greater in C_6H_6 and CCl_4 when referred to the polarisation in C_6H_{10} as unity. The explanation suggested is that the dipole moment is situated eccentrically with respect to the molecule. A. M. T.

See also Abstracts 2816, 3162.

ELECTROCHEMISTRY.

3156. E.M.F. of Cadmium Chloride Cells. (Miss) M. Quintin. *Comptes Rendus,* 200. *pp.* 1579–1580, *May* 6, 1935.—The e.m.f. of the cell CdHg (amalgam 2 phases)$|CdCl_2(c)|AgCl|Ag$ between 0° and 45°, and for concentrations (c) 0·1 – 0·001 M increases as temperature rises and concentration falls, *e.g.* from 0·6958 V for $c = 0{\cdot}1\,M$ at 0° to 0·8376 V for $c = 0{\cdot}001\,M$ at 40°. The e.m.f. - temperature curves consist of two intersecting linear portions, which probably implies that in addition to the normal reaction, $Cd + 2AgCl = CdCl_2 + 2Ag$, there is also formation of some compound between $CdCl_2$ and AgCl. [See following Abstract.] C. A. S.

3157. Application of Debye's Theory to Solutions of Cadmium Chloride. (Miss) M. Quintin. *Comptes Rendus*, **200.** *pp.* **1754–1755,** *May* **20, 1935.**—Application of Gronwall's equation to the cell Cd(amalgam two phases)|$CdCl_2(c)$|AgCl|Ag shows that it only applies to even more dilute solutions of $CdCl_2$ than of $CuSO_4$, while the increase in the ionic radius with rise in temperature in this case is even more rapid. [See preceding Abstract.] C. A. S.

3158. Electrolysis of Solid Solutions. W. Jost and R. Linke. *Zeits. f. phys. Chem.* **29.** *Abt.B.* **2.** *pp.* **127–132, 1935.**—The passage of current through a wire consisting of a Au-Pd alloy, at a temperature of 900° C., was found to be accompanied by transport of material. Small changes in concentration of the two metals were found by means of X-ray methods at the ends of the wires. The transport number for Pd was found to be approximately 10^{-11} at 900° C. An increase of Au was found at the anode, by similar experiments to those made by Seith and Etzold on Au-Pb alloys. F. J. B.

3159. Electrochemistry of Solid Cadmium-Antimony Alloys. A. Ölander. *Zeits. f. phys. Chem.* **173.** *Abt.A.* **4.** *pp.* **284–294, 1935.**—The electrochemical potentials of Cd-Sb alloys were measured between the temperatures of 240° and 290° C. The electrolyte consisted of fused sodium and potassium acetate. The existence of a stable compound CdSb is shown and the thermodynamic constants for its formation are calculated. The degree of disorder (*Unordnungsgrad*) is determined for the space lattice of the crystalline compound. F. J. B.

3160. Temperature Variation of Ionisation Constants in Aqueous Solutions. A. W. Walde. *J. Phys. Chem.* **39.** *pp.* **477–484,** *April,* **1935.**—According to Harned and Embree (*Am. Chem. Soc., J.* **56.** *p.* **1050, 1934**), the temperature variation of the ionisation constant can, as a first approximation, be represented by the quadratic equation, $\log K - \log K_m = -p\,(t-\theta)^2$, where K is the ionisation constant, K_m its maximum value, p a general constant of the value $5{\cdot}0 \times 10^{-5}$ deg.$^{-2}$, t the Centigrade temperature, and θ the temperature at which $K = K_m$. Published values of $-p$ show, however, that $-p$ has not the above constant value and that p is not a constant characteristic of any particular acid unless the variation of log K with temperature is originally expressed as a quadratic equation. The theoretical significance of p and its relation to $d \log K/dT$ and $d^2 \log K/dT^2$ are pointed out and the significance of the third derivative is indicated. T. H. P.

3161. Potential Dissociation Effect. F. Michels. *Ann. d. Physik,* **22. 8.** *pp.* **735–747,** *May,* **1935.**—An attempt is made to clear up some of the difficulties met with in the study of the conductivity of electrolytes at high potentials. The potential dissociation effect is measured in acetic acid of various concentrations and it is shown that low concentrations have little effect whereas a strong concentration has a marked effect. The measurements of Bauer on the relation between the dissociation effect and the time of application of the potential are checked with 6 salts and, with acetone as a solvent, it is found that monovalent salts show a small effect whereas divalent show a much greater effect. The work of Schiele on agar-agar is extended to silicic acid and gelatin. The former behaves like agar-agar whilst the latter shows no alteration in conductivity on altering the potential but a marked change on altering the frequency. The effect in semi-conductors is also briefly mentioned. H. J. H. S.

3162. Properties of Electrolytes. C. A. Kraus. *Am. Electrochem Soc., Trans.* 66. *pp.* 179–203; *Disc.*, 203–204, 1935.—By taking into account specific as well as distributed interaction between ions due to Coulomb forces, a general theory of electrolytes results which accounts for the properties of electrolytic solutions in all solvents whatever the value of their dielectric constant. The influence of specific interaction is the greater, the lower the dielectric constant of the solvent medium. Due to specific interaction, ions associate to ion-pairs and to more complex neutral aggregates as well as to " triple " ions and more complex charged aggregates. The results of experiment are quantitatively accounted for at lower concentrations and qualitatively at higher concentrations. Specific ionic interaction effects depend upon the size, shape, and charge distribution of the ions. In solvents of low dielectric constant, the constitutional factors come to light. The conductance, freezing point and molecular polarisation of electrolytes in solution are considered. AUTHOR.

3163. Electrolysis of Aqueous Solutions of Ammonium Chloride. F. Jirsa. *Zeits. f. Elektrochem.* 41. *pp.* 321–330, *June*, 1935.—The electrolysis of aqueous ammonium chloride solutions is investigated under various conditions, the products and their respective yields being especially studied. In the cold NH_3 and H_2 are formed at the kathode and Cl_2, N_2, $NHCl_2$ and some HCl at the anode. With warm solutions the kathodic products are the same as in the cold, while HCl and N_2 (but no Cl_2) are formed at the anode. Only under special conditions is NCl_3 produced, namely, with concentrated electrolyte in absence of stirring, between 35 and 40° C. and at low current densities. A detailed mechanism of the chemical processes involved is put forward. Experiments are also carried out without a diaphragm and with excess ammonia in the solution. L. A. W.

3164. Mechanism of the Ionisation of Hydrogen at a Platinum Electrode. J. Horiuti and M. Polanyi. *Manchester Lit. and Phil. Soc., Mem.* 78. *pp.* 47–54, 1933–1934.—Haplogen (H^1), brought into contact with normal water in the presence of platinum black, is exchanged rapidly for ordinary hydrogen. It is suggested that the H^2 atoms are taken into the solution as $(H^2)^+$ ions. A. S. C. L.

3165. Surface Layers on Iron. S. Procopiu and D. Umanschi. *Comptes Rendus*, 200. *pp.* 1395–1396, *April* 15, 1935.—The existence on electrolytic iron of a thin surface layer of distinctive properties, already demonstrated magnetically [see Abstract 3034 (1934)], is confirmed electrochemically. A carefully dried electrode when first immersed in the electrolyte is found to be electronegative to a similar electrode which has been immersed long enough for the surface layer to dissolve away. The e.m.f. diminishes to 0 in about 40 min. A similar effect is observed with thin films of electrolytic copper. The surface layer is computed to be approximately 8 $m\mu$ thick, and its special properties are attributed to adsorbed gases. C. E. W.

3166. Effect of Mechanical Agitation on Electrode Potential. F. O. Koenig. *J. Phys. Chem.* 39. *pp.* 455–462, *April*, 1935.—The electrokinetic theory of the effect of mechanical agitation upon electrode potential is critically discussed. It is pointed out that this theory is not the only possible explanation, an alternative being the theory that irreversible chemical processes are partly or wholly responsible for the effect. Experiments with Ag electrodes in KCl solutions saturated with AgCl and in $AgNO_3$ solutions are described which lend support to the chemical theory of the effect. AUTHOR.

See also Abstracts **3019, 3087, 3151.**

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

3167. Negative Proton. G. Gamow. *Nature,* 135. *pp.* 858–861, *May* 25, 1935.—Dirac's arguments for the positron do not apply, as the radius of the proton, r_p, is of the same order as the critical length, l_p. This fact further explains the apparent difficulty of the magnetic moments of P_+ and H^2 being respectively 2·5 and 0·7 nuclear magnetons, making that of the neutron apparently − 1·8 instead of 0. [See Abstract 5075 (1933)]. The negative proton, P_- must be symmetrical with the positron, giving the general scheme $P_{-} \underset{\beta_{+}}{\overset{\beta_{-}}{\rightleftarrows}} n \underset{\beta_{+}}{\overset{\beta_{-}}{\rightleftarrows}} P_{+}$. There must be strong repulsion between P_+ and P_- at nuclear distances and hence no or $\ngtr$ one P_- in light, and but few in heavy nuclei. The existence of metastable isomeric nuclei containing P_+ and P_- in place of $2n$ is suggested as explaining the relation between UX_2 and UZ, and between RaD and ${}^{210}_{82}Pb$; while the fact that for P_- there is no potential barrier around nuclei makes reactions of the type ${}^{m}_{n}X + {}^{1}_{0}n \rightarrow {}^{m}_{n+1}Y + {}^{1}_{-1}p$ probable for heavy elements, and may explain some of Fermi's results. C. A. S.

3168. New Determination of the Elementary Electric Charge. E. Schopper. *Zeits. f. Physik,* 94. 9–10. *p.* 649, *April* 16, 1935.—A correction is found to be necessary in the values given in a previous paper [see Abstract 881 (1935)] for the elementary electric charge, owing to a deviation in the e.m.f. of the standard cell that was used. The measurements will therefore be repeated. H. L. B.

3169. Ratio 136/137 in Atomic Physics. W. N. Bond. *Nature,* 135. *p.* 825, *May* 18, 1935.—Further evidence is offered in support of the author's suggestion that the cause of the discrepancy between experiment and Eddington's theoretical value of M/m is that experiment measures not e/m for the electron but 136/137 e/m. Also it is suggested that since X-ray determinations and Millikan's method give different values for the electronic charge, approximately in the ratio 137/136, the reason for this lack of agreement is the same as in the first case, namely, faulty analysis of a " system " into " parts." AUTHOR.

3170. Definition of Effective Cross-Sections. J. Winter. *J. de Physique et le Radium,* 6. *pp.* 182–184, *April,* 1935.—The physical sense that may be given to effective cross-sections is studied and in particular, the significance of the fact that they may become infinite for incident waves of the lowest velocity. This enables the author to give a simple theory of the diffraction of pencils without introducing diaphragms or Huygens' principle, but only the properties of the development given by Rayleigh. H. L. B.

3171. Properties of Electron Waves. M. Steck. *Zeits. f. Physik,* 94. 7–8. *pp.* 489–495, *April* 8, 1935.—The physical nature of electron (de

Broglie) waves is further discussed [see Abstract 1832 (1935)]. From certain properties of these waves the author is led to regard them as h.f. electromagnetic radiation of the nature of X-rays and γ-rays. A formula is derived for the continuous spectrum of electron waves which exhibits the relationship between de Broglie waves and the naturally connected light-quantum of constant wave-length $\lambda_0 = 0\cdot0242 \times 10^{-8}$cm. H. L. B.

***3172. Duplex Kathode-Ray Oscillograph. L. Garceau.** *Rev. Sci. Instruments,* 6. *pp.* 171–172, *June,* 1935.—A method is described for simultaneous visualisation or photography of two separate phenomena, either transient or repetitive in nature, on the screen of a single kathode-ray oscillograph. AUTHOR.

3173. Emission of Electrons under the Influence of Chemical Action. A. K. Denisoff and O. W. Richardson. *Roy. Soc., Proc.* 150*A*. *pp.* 495–519, *July* 1, 1935.—The heterogeneous reactions between liquid NaK_2 and gaseous ClCN, $HgBr_2$, $(OH)_2$, and O_3, at very low pressures, give rise to a negative emission from the metal, comparable with that observed with the gaseous halogens, while the reactions of CH_3Cl, $(CN)_2$, $Hg(CN)_2$, and H_2S give a very small negative emission. The data are consistent with the general interpretation of the electron emission mechanism, and the electron energy distribution functions are also accounted for by the theory [see Abstract 1847 (1935)]. The constants k and m, which determine the form of the de-excitation function representing the chance of an effective collision of the second kind between a free metal electron and the electronically excited chemical bond, are the same as those derived from the previous reactions involving halogen atoms. The de-excitation function with these constants has, thus, quite general properties. Some related effects and other aspects which call for investigation are briefly indicated. AUTHORS.

See also Abstracts 2781, 2791, 2792, 2856, 2863, 2959, 3079.

ELECTROSTATICS.

3174. Mean Values of the Electric Force in a Random Distribution of Charges. L. S. Ornstein. *K. Akad. Amsterdam. Proc.* 38. 5. *pp.* 491–494, 1935.—Holtsmark's deduction of the frequency law of the electric field caused by a random distribution of electric charged ions, dipoles, quadrupoles surrounding an atom of given radius is rather complicated and an elementary mode of calculation is now derived. A random distribution of ions surrounding the atom is assumed together with no correlation of the probability of the numbers in the elements of volume, when it is found that $\overline{X}^{2p} = 1\cdot3\cdot(2p-1)\left\{\frac{4e^2\rho}{3a}\right\}^p = 1\cdot3\cdots2p-1\cdot\overline{x}^{2p}$ Similarly for the mean force in the case of dipoles, $\overline{X}^{2p} = 1\cdot3\cdot\cdot(2p-1)\,\bar{r}^2$. The mean values are then derived for the case when a correlation of probabilities is assumed, and found to $\overline{X}^2 = e^2\rho\ 4\pi/3a\left(1-\frac{8\pi\bar{r}^2}{3a^2}\right)$ for a positive and $\overline{X}^2 = e^2\rho 4\pi/3a\left(1+\frac{8\pi\bar{r}^2}{3a^2}\right)$ for a negative correlation.

H. H. Ho.

See also Abstracts 2849, 2862.

MAGNETISM AND ELECTROMAGNETISM.

3175. Propagation of Wave of Magnetic Reversal. D. S. Steinberg. *Phys. Zeits. d. Sowjetunion,* 7. 2. *pp.* 155–174, 1935. *In German.*—In experiments on the propagation of the wave of magnetic reversal in wires of pure nickel and 10 % Ni-Fe alloys, which had been stretched almost to their elastic limit, the following results were obtained. The magnetisation at any point in the material reverses only when the demagnetising field at that point has reached a definite value which depends on the deformation of the wire. A progressive wave sets up a frontal field which is in the same direction as the external field and assists any further reversal which may take place. Calculation of the maximum frontal field gives an expression of the form $H_f = 4\pi I_s\, d/l$, where d is the dia. of the wire and l the distance at which the change in induction from zero to the limiting value $4\pi I_s$ is observed. With a previous reversal of the magnetisation in a small portion of the wire, the frontal field of this "germ" is proportional to its magnetic moment. If the germ is very small, it can cause reversal only when the external field borders on the critical value. When the magnetisation is already reversed in a large part of the wire, and the frontal field has attained its limiting value of about 2 oersteds, the process of reversal may extend into the external field when that is less than the critical value by the same amount. The effect of the frontal field can be used to explain the formation of unsymmetrical curves of cyclic magnetisation and also the absence of large discontinuities in the primary magnetisation curve. [See also Abstracts 3234 (1931), 2132 (1932) and 4720 (1934).] G. E. A.

3176. Magnetic After-Effect. F. Preisach. *Zeits. f. Physik,* 94. 5–6. *pp.* 277–302, *April* 2, 1935.—To test the hypothesis that the a.c. loss component introduced by Jordan is caused by magnetic after-effect [see Abstract 2840 (1924)], it is assumed that the effect is analogous to dielectric after-effect. To prove this assumption, three experiments are made: (1) measurement of the dependence of permeability on frequency, (2) observation of the retardation of induction at make, and (3) the same observation after make and break. The first and second experiments confirm the expectations of the classical theory as regards order of magnitude, but the result of the make and break experiment is in direct opposition to the formal theory. The observation (on a ribbon core of Fe-Ni alloy) that the retardation at break is independent of the time of make proves rather that the principle of superposition is inadmissible in the case of magnetic after-effect. For the interpretation of the make and break experiments it is assumed that the after-effect is caused by the gradual reversal of Barkhausen regions. The quantitative connection of the retardation function of the make and break experiment with the Jordan loss component is not yet explained. G. E. A.

3177. Influence of Fibrous Structure and Cooling in the Magnetic Field on the Course of Magnetisation. O. Dahl and F. Pawlek. *Zeits. f. Physik,* 94. 7–8. *pp.* 504–522, *April* 8, 1935.—The influence of fibrous structure on the magnetisation curves of iron-nickel alloys is examined; also the influence of cooling in the magnetic field, as given by Bozorth, Dillinger and Kelsall, is studied with respect to fibrous and quasi-isotropic samples, and alloys containing a considerable percentage of iron. The results are discussed in detail. H. L. B.

3178. Movement and Demagnetisation of Ferromagnetic Particles in Alternating Magnetic Fields. C. W. Davis. *Physics,* 6. *pp.* 184–189, *June,* 1935.—The movement of ferromagnetic particles in various types of alternating magnetic fields and the mechanisms involved are discussed. The conditions under which demagnetisation takes place in magnetic fields produced by damped h.f. oscillatory discharges are described, and possible practical applications to the magnetic separation of ores and to routine laboratory magnetic testing of iron and steel are indicated. AUTHOR.

3179. Weiss Constant of Paramagnetic Ions in the S-State. Part II. Aqueous Solutions of Ferric Salts. A. Bose. *Indian Acad. Sci., Proc.* 1.A. *pp.* 754–763, *April,* 1935.—In the ferric salts $FeCl_3$, $Fe(NO_3)_3$ and $Fe_2(SO_4)_3$, the susceptibilities deviate considerably from the simple Curie law; also they do not conform to the more general Weiss law. The deficit of χT from its theoretical value, 4·36, is least for the chloride and greatest for the sulphate. In a given solution the deficit is, in general, more marked at the higher temperatures, although in the chloride solutions the deviation is not much affected by temperature. The more dilute the solution, the greater is the deviation of χT from the theoretical value; but the addition of acid reduces the deviation, and with sufficiently large acid concentration χT reaches the value 4·36 and is also independent of temperature. [For Part I see Abstract 2748 (1935).] G. E. A.

3180. Ozone and Its Magnetic Properties. P. Lainé. *Ann. de Physique,* 3. *pp.* 461–554, *May–June,* 1935.—Previous results have been very discordant as to the nature of magnetism of O_3. Becquerel and Schumeister record O_3 as being more paramagnetic than O_2. Wulf and Vaidayanathan state that it is probably diamagnetic, whilst Piccard and Bonazzi find that freshly prepared O_3 should have a susceptibility less than that of O_2, and in ageing would undergo a change which will ultimately render it more paramagnetic than the latter body. The present work may be summarised as follows: (1) The Piccard and Bonazzi experiments have been repeated many times without any result. The transformation was not observed. (2) The magnetic susceptibility has now been studied by the author in the liquid form. Difficulties were encountered on account of the explosive nature of the O_3 and also because the value of the susceptibility as compared with that of O_2 is so small. The specific susceptibility of O_3 is given as $+1\cdot4 \pm 0\cdot2 \times 10^{-7}$ in the liquid form. This value is independent of the temperature. (3) The author considers that the constant paramagnetism of liquid O_3 may be explained by a deformation of the molecules under the influence of an external field. (4) In the course of the work a certain number of other results are recorded in regard to the solubility of O_2 in liquid O_3, in regard to the stability of the latter, and also the possibility of pursuing its purification to a considerable amount. (5) The author has sought without success up to the present to obtain evidence of products of the formula O_n where $n > 3$. The paper is lengthy and full of references and gives a complete review of the position in relation to the subject. S. G. B.

3181. Adiabatic Demagnetisation of Cæsium Titanium Alum. W. J. de Haas and E. C. Wiersma. *Physica,* 2. *p.* 438, *May,* 1935. *In English.*—The demagnetisation of pure cæsium titanium alum $(Cs_2SO_4,Ti_2(SO_4)_3,24H_2O)$ gave calculated temperatures of about

0·0055° K. with an initial field strength of 25075 gauss and an initial temperature of 1·314°K. AUTHORS.

3182. Principal Susceptibilities of Rare Earth Ethylsulphates. R. A. Fereday and E. C. Wiersma. *K. Onnes Lab., Leiden, Comm.* 237*a*. *Physica*, 2. *pp.* 575–581, *June*, 1935. *In English.*—The ethylsulphates of the rare earths form hexagonal crystals. Therefore there exist only two principal susceptibilities so long as molecular fields are absent. The difference of these susceptibilities has been determined for the ethylsulphates of Ce, Nd, Pr, and Er. Of these, Ce, Nd, and Er have an odd number of electrons in the ion. They show the highest value of susceptibility along the principal axis and this difference increases rapidly at lower temperatures. Pr has an even number of electrons in the ion; here at room-temperature the susceptibility is still highest along the principal axis, but at about 130° K. the susceptibilities are equal, and at still lower temperatures the susceptibility along the binary axis is highest, the difference still rapidly increasing at liquid hydrogen temperatures. AUTHORS.

3183. Temperature Dependence of the Susceptibility of Solid Nitric Oxide. E. Lips. *Helv. Phys. Acta*, 8. 3. *pp.* 247–264, 1935. *In German.*—Measurements of the magnetic susceptibility of solid NO from 135° to 300° Abs. obey van Vleck's theory of temperature dependence. W.R.A.

3184. Magnetic Susceptibility of Cerium Chloride in Aqueous Solution. Jeanne Liquier-Milward. *Phys. Soc., Proc.* 47. *pp.* 559-570, *July*, 1935.—Measurements on the paramagnetic susceptibility of $CeCl_3.6H_2O$ in aqueous solutions containing 8 to 37·5 % of the anhydrous salt, and between 7° and 70° C. have been made by means of a modified Quincke ascension method. The molecular susceptibility is found to follow a Curie-Weiss law $\chi_c (T + \Delta) = C$, with C equal to 0·762. The value of C appears to be unaffected by the concentration of the solution. Δ varies with the number of ions present in the unit of volume and increases from 45 to 63 for this range of concentration. The effective magneton number μ_e or $14{\cdot}07 \sqrt{(\chi_c T)}$ of the ion Ce^{+++} at room-temperature is calculated and is found to vary, for this same interval of concentrations, from 11·41 to 11·16. If, on the other hand, the magneton number is deduced from the modified form of the above formula, $\mu_w = 14{\cdot}07 \sqrt{\{\chi_c(T + \Delta)\}}$, a value is obtained which is independent of the concentration and of the temperature and is equal to 12·36. These results are compared with the values obtained by other workers. Measurements on the densities of the solutions under investigation are included. AUTHOR.

3185. Interpretation, in Terms of Absolute Vectors, of Linear Tensors of the Third Order and Application to the Stationary Electromagnetic Field. M. Manarini. *Accad. Lincei, Atti*, 21. *pp.* 173–178, *Feb.* 3, *and pp.* 277–283, *Feb.* 17, 1935.—Develops certain mathematical relations based on the concept of hyperhomographics (linear operators transforming a set of *n* vectors into one vector) and applies the results to express the equations of the stationary electromagnetic field in a form independent of the system of coordinates and having significance whatever the number of dimensions of space. W. S. S.

3186. Electromagnetic Fields Due to Variable Electric Charges and the Intensities of Spectrum Lines According to the Quantum Theory. H. R. Hulme. *Roy. Soc., Proc.* 150*A*. *pp.* 416–421, *June* 1, 1935.—It is shown that Schott's treatment [see Abstract 1645 (1933)] of

the radiation emitted by an atom is equivalent to the strict quantum mechanical treatment. The latter, however, affords a simpler method of calculating the intensities accurately, and allows us to make some estimate of the error involved by treating the atom as a dipole.
AUTHOR.

3187. Variations of Elasticity Coefficients of Nickel/Iron Alloys Due to Magnetisation. K. Nakamura. *Zeits. f. Physik,* 94. 11–12. *pp.* 707–716, *May* 3, 1935.—Young's modulus for these materials was measured by means of an improved magneto-striction oscillator. The results for Ni/Fe alloys are recorded in the present paper. The increase or decrease of the Young's modulus due to magnetisation is small if the Ni content is below 30 %, in contrast to the tolerably high variations for higher percentages of Ni. The results confirm the previous records of Kersten and Becker obtained theoretically for the higher points. The value of $\Delta E/E$ for the alloys is smaller than that for pure nickel. Below 30 % nickel the value is small and negative, *i.e.,* the value of E when magnetised is somewhat smaller than when untreated. As the Ni content increases the value of E increases rapidly to a maximum at about 50% Ni, then further increase to 70 % creates a fall to a minimum, whereafter up to 100 % the value again increases. The theoretical issues are discussed.
S. G. B.

3188. Magnetostriction of Bismuth Single Crystals. D. Shoenberg. *Roy. Soc., Proc.* 150*A. pp.* 619–637, *July* 1, 1935.—The magnetostriction of Bi single crystals was recently observed for the first time by Kapitza, who was able to measure the longitudinal effect in very high magnetic fields. To obtain a complete description of the phenomenon, the transverse effect has also to be investigated, and this work was carried out in the relatively low fields of an electromagnet, below 20,000 gauss. Since diamagnetic magnetostriction varies as the square of the magnetic field, the change of length to be measured was extremely small, 5×10^{-7} cm, and a special magnification method, based on a hydraulic principle, was developed to make the measurement possible. The results of experiments with this new method confirm the general feature of the phenomenon found by Kapitza, and are expressed in terms of 8 moduli of magnetostriction whose numerical values are given. The anomalous temperature variation of diamagnetic susceptibility is discussed.
AUTHOR.

See also Abstracts 2836, 2848, 2862, 3107, 3139, 3143.

MEDICAL RADIOLOGY AND ELECTROLOGY.

3189. Emission of Radiation from Excited Nerves. R. Audubert and R. Lévy. *Comptes Rendus,* 200. *pp.* 1634–1636, *May* 6, 1935.—A photoelectric counter previously used for detecting radiations produced by chemical reactions, is used to investigate biological phenomena. Two types of photoelectric kathode were used, one of Al (maximum sensitivity 2300–2400 Å) and one of iodised copper (max. sensitivity 2000–2400 Å). It is suggested that the previous contradictory results in this field are due to the use of cells which are insensitive to the range of wave-lengths produced. Excitations of frequency about 40 cycles were produced electrically and mechanically in the sciatic nerve of a frog. Radiations of wave-length approx. 2350 Å were easily detected, the energy corresponding to 1000 to 10,000 photons per sec. per cm.^{2}.
J. E R.

3190. Influence of Atmospheric Ozone on the Biological Activity of Solar Radiation. R. Latarjet. *Comptes Rendus,* 200. *pp.* 1437–1439, *April* 15, 1935.—An expression for the biological activity of solar radiation is given which involves among other factors one taking into account the absorption of a layer of ozone of assumed thickness. Numerical calculations shew that the biological activity expressed in Finsens varies from 68·7 with no ozone to 0·73 corresponding to an ozone layer 0·6 cm. thick. It is concluded that radiation dosage should be estimated by a recorder (*e.g.*, a photoelectric cell) of appropriate sensitivity curve, and that a time basis of dosage is likely to lead to serious errors. G. E. B.

3191. Absolute Determination of the Local X-Ray Dose from an Extended Source. A. Rogozinski. *J. de Physique et le Radium,* 6. *pp.* 168-174, *April,* 1935.—The " local dose " is defined as $Q = dq/dv$, q being the total electric charge liberated in a volume v, while " local dose per second " is defined as $I = di/dv$ when i is the ionisation current. If q and i are given in e.s.u., Q and I are given in röntgens and röntgens per second. Mathematical expressions for I are developed for point-sources, valid for long-wave radiation and wide beams. The method of defining intensity at a point in space is discussed, and two cases are considered, (*a*) a definition based on energy flux and (*b*) one based on absorption which, together with a factor based on the ionisation potential of air is identical with dosage rate. Finally the difficulties in formulating definitions of absolute dosage are considered. G. E. B.

***3192. Ionisation Chambers for X-Ray Dosage Measurement. Part II. H. I. Jones.** *Brit. J. of Radiology,* 8. *pp.* 318–332, *May,* 1935.—A detailed description is given of the characteristics and use of a parallel-plate ionisation chamber suitable for absolute measurements of X-ray dosage rates for voltages up to 200 kV. Saturation and plate separation problems are investigated and it is found that consistent results are obtained if the volume ionised is calculated in terms of the effective cross-section of the beam, allowance being made for penumbral effects. Using unfiltered radiations at 110 to 170 kV it is found that the ionisation in thick-walled graphite chambers is not exactly proportional to the volume of the air cavity. A general explanation of this phenomenon in terms of scattered radiations from the walls is suggested. The indications of the standard chamber and a graphite chamber are compared under varying conditions. In the case of unfiltered radiations, the ratio of the dose indicated by the graphite chamber to the corresponding air chamber dose is found to increase slowly as the operating voltage increases from 110 to 180 kV. [See Abstract 3973 (1931).] J. E. R.

3193. Null Method in Radium Dosimetry. P. Kipfer. *Helv. Phys. Acta,* 8. 3. *pp.* 267–271, 1935. *In German.*—The method devised by Piccard and Meylan [see Abstract 1090 [1934)] for comparing the γ-ray activity of small Ra preparations, is considered from the point of view of accuracy. In this method two ionisation chambers are used, one with a standard Ra source at a fixed distance, and the other with the source to be measured at a variable distance. When small and almost equal radioactive sources are used, difficulties arise owing to the movement and inertia of the electrometer fibre. These difficulties are discussed and the effects of time of observation and method of measurement investigated. J. E. R.

***3194. Flexible Radium Bomb with Adequate Protection. W. S. Newcomet and B. A. Hughes.** *Am. J. Roentgenology and Radium Therapy,* 33. *pp.* 694–697, *May,* 1935.—Describes the construction of a bomb, or container, for the application of radium salts for therapeutic purposes. The apparatus is illustrated and its construction shown by a diagram. Whilst generally it conforms in its construction with similar apparatus, the particular construction has as its special features, flexibility of operation, treatment of a patient at any desired position or angle, the possibility of treating a patient at varying distances, whilst maintaining the area of the field treated constant, adequate protection of the operator from direct and scattered radiation and the production of a homogeneous field of irradiation. B. J. L.

See also Abstract 3076.

OSCILLATIONS.

***3195. Grating Theory and Study of the Magnetostatic Oscillator Frequency. C. E. Cleeton.** *Physics,* 6. *pp.* 207–209, *June,* 1935.—A special type of echelette grating for wave-length measurements of ultra-short electromagnetic waves is described. The one grating may be used over the entire wave-length range from 1 to 10 cm. without loss of effectiveness due to an automatically changing groove form which keeps the direction of the centre of the diffraction pattern fixed. The formula for the distribution of the energy diffracted from the grating is given and found to agree with the experimental values. The magnetostatic oscillator produces a band of frequencies unless it is adjusted for the conditions at which the tube gives the maximum output, in which case no conclusions as to the width of the band could be drawn as the resolution of the spectrometer was too low. [See Abstract 1576 (1934).] AUTHOR.

See also Abstracts 2844, 3141, 3142, 3143.

PHOTOELECTRICITY.

3196. Photoelectric Behaviour of Compound Surface Layers at Low Temperatures. R. Suhrmann and D. Dempster. *Zeits. f. Physik,* 94. 11–12. *pp.* 742–759, *May* 3, 1935.—The spectral selective photoeffect of a compound kathode (K-naphthalene-K and K-KH-K kathodes) is found to exhibit at low temperatures a fatigue phenomenon when irradiated with light of its spectral maxima, which, however, is removed by rise of temperature or by red illumination at low temperatures. Hereby are electrons emitted. The phenomenon has a parallel in the storing of light energy by cooled P. Full experimental details are included while a theoretical explanation is submitted based on the assumption of excited centres of some duration. H. H. Ho.

3197. Temperature Variation of the Photoelectric Emission from Thorium Oxide. J. H. Marchant, Jr. *Physics,* 6. *pp.* 202–206, *June,* 1935.—The photoelectric emission from a Pt filament coated with thorium oxide seems to be due chiefly to that part of the spectrum lying between 2500 Å and 3100 Å. An increase in the photoelectric emission from the thorium-oxide-coated platinum filament was observed with increasing temperature from 23° C. up to about 200° C., and a decrease from the same filament with increasing temperature from 200°C. to about 400°C. A definite photoelectric emission was observed from this filament whether the corresponding thermionic current was saturated or not. No photoelectric fatigue was observed. AUTHOR.

See also Abstracts 2782, 2962, 2967, 3016, 3141, 3142.

THERMIONICS.

3198. Thermionic Properties of Tantalum. A. B. Cardwell. *Phys. Rev.* 47. *pp.* 628–630, *April* 15, 1935.—Tantalum was carefully outgassed and its photoelectric and thermionic properties simultaneously studied. As was shown in a previous paper [see Abstract 1729 (1932)] heating 1000 hours at temperatures up to 2200° K. produced an apparent stable condition of the surface. Further heat treatment at temperatures up to 2500° K. produced a final stable condition. The values obtained for the thermionic constants of the T^2 law are, when corrected for the Schottky effect, as follows: (1) for surface in first apparent stable condition, $b = 52{,}532°$ K. and $h = 4 \cdot 53$ volts. (2) For surface in final stable condition, $b = 47{,}560°$ K., $h = 4 \cdot 10$ volts and $A = 37 \cdot 2$ amperes/cm.^{2} degree^2. A comparison of these results with the previously published photoelectric data shows that the value of the photoelectric work function determined according to Fowler's method agrees with the value of the thermionic work function of the same surface regardless of whether the surface is thoroughly outgassed. AUTHOR.

3199. Mobility of Sodium on Tungsten. R. C. L. Bosworth. *Roy. Soc., Proc.* 150*A*. *pp.* 58–76, *May* 1, 1935.—By depositing a small patch of sodium on the centre of a tungsten strip filament and traversing the strip from time to time with a well-defined spot of light, the photoelectric properties have been used to measure the mobility of the sodium film. It has been observed first of all that a clean strip absorbs sodium, a portion of which, however, reappears on the surface from which it evaporates when the strip is heated above 1300° K. There is a limit to the capacity of the strip to absorb sodium, and once that limit has been reached any excess sodium is stable on the surface and, if deposited as an active patch, spreads or migrates over the surface at such a rate that the strip is approximately uniformly active after 1 or 2 hours at 300° K. or 5 to 10 seconds at 800° K. An activation energy of 0·25 volt is indicated for this migration and within experimental error the same energy is associated with the absorption process leading to the conclusion that this latter consists of migration down slip planes and intercrystalline cracks. [See Abstract 5093 (1933).] AUTHOR.

3200. Formation of Ions from Heated Salts. H. Mentrup. *Phys. Zeits.* 36. *pp.* 335–340, *May* 1, 1935.—A hollow cylindrical bundle of nickel wires was dipped into solutions of CdI_2, $TlCl_2$, $PbCl_2$, AgBr and LiCl respectively and the emission of ions on heating the surface of the coated wires was observed with a central nickel wire electrode connected to a galvanometer. The current increased with (1) increased area of surface, (2) temperature, (3) reduction of pressure, values of 10^{-7} ampere being obtained. With increasing electrode potential the current rose rapidly, no evidence of saturation being observed even when the potential reached 90 V. Exceptional behaviour was noticed with LiCl which exhibited a saturation potential at 30 V. By enclosing the bundle of nickel wires in a nickel cylinder closed at both ends except for one small aperture opposite which a flat platinum plate was placed, a fine beam of ions of 10^{-6} ampere suitable for analysis with a mass-spectrograph was obtained. F. C. C.

THERMOELECTRICITY.

See Abstract 2986.